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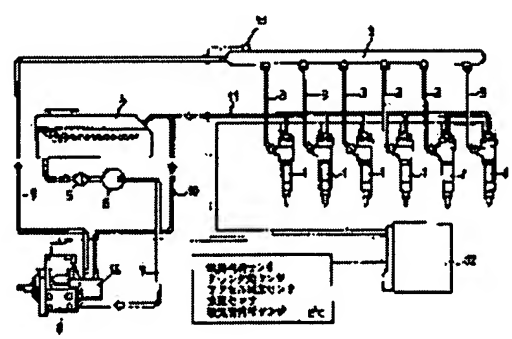
(54) COMMON RAIL TYPE FUEL INJECTION DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent production of noise and deterioration of exhaust emission by stopping the feedback control of sub-injection, when the target sub-injection amount in sub-injection is smaller than the minimum fuel injection amount detected according to common rail pressure.
SOLUTION: In a system, where fuel injection is divided into main injection and sub-injection preceding the main injection or delayed from it according to the detection signal from a detecting means for detecting fuel injection from an injector 1 provided on every cylinder, a target sub-injection amount Qt obtained according to the engine operating conditions and a preset value Q1 of fuel injection amount obtained corresponding to a pressure Pr of a common rail 2 detected by a pressure sensor 3 immediately before the start of sub-injection are compared by a controller 12. When Qt<Q1, feedback control of sub-injection is stopped to cause open-loop control to be conducted, for example. Thus, combustion can be kept from being unstable.



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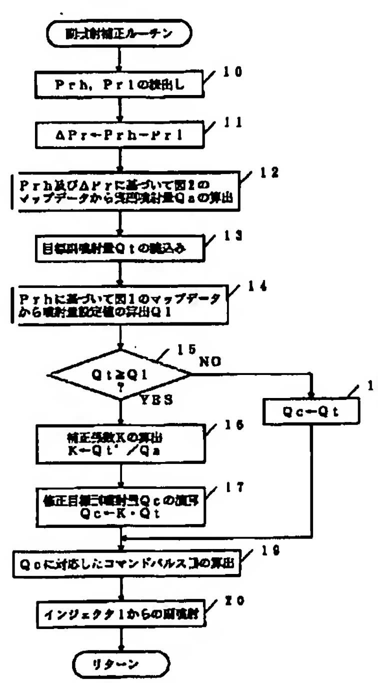
(54)【発明の名称】　コモンレール式燃料噴射装置

(57)【要約】

【課題】　パイロット噴射量のような副噴射において、目標副噴射量が一定の値に満たない場合には、フィードバック制御を停止して、燃焼が不安定になるのを回避するコモンレール式燃料噴射装置を提供する。

【解決手段】　ステップ１５における比較において、エンジンの運転状態から算出される目標副噴射量Ｑｔが、コモンレール圧力と燃料噴射に伴うコモンレール圧力の降下量とから検出限界として算出される最少燃料噴射量Ｑｌ（或いは、最少燃料噴射量Ｑｌに基づいて設定される燃料噴射量設定値）に満たない場合には、ステップ１８において修正目標副噴射量Ｑｃとして最少燃料噴射量Ｑｌを設定して、修正目標副噴射量Ｑｃに基づいて燃料噴射を行い、副噴射におけるフィードバック制御が不安定になるのを回避する。



【特許請求の範囲】

【請求項１】　高圧燃料ポンプから吐出された燃料を蓄圧状態に貯留するコモンレール、前記コモンレールから供給される燃料を燃焼室に噴射するインジェクタ、エンジンの運転状態を検出する検出手段、前記コモンレールの燃料圧力を検出する圧力センサ、及び前記検出手段からの検出信号に応じて前記インジェクタから噴射すべき燃料の目標噴射量を求め、前記目標噴射量に基づいて前記インジェクタからの燃料噴射を制御するコントローラを具備し、前記コントローラは、前記インジェクタからの前記燃料噴射を前記検出手段からの検出信号に応じて主噴射と該主噴射に先行又は遅延する副噴射とに分割し、目標副噴射量を前記検出手段からの検出信号に応じて算出し、前記コモンレールの前記燃料圧力の降下量に基づいて前記副噴射において実際に噴射された燃料の実副噴射量を算出し、前記実副噴射量が前記目標副噴射量に一致するように前記副噴射のフィードバック制御を行うことから成るコモンレール式燃料噴射装置において、前記コントローラは、前記目標副噴射量と前記圧力センサが検出した前記コモンレールの燃料圧力に対応して求められる燃料噴射量設定値とを比較し、前記目標副噴射量が前記燃料噴射量設定値よりも小さい場合には前記フィードバック制御を停止することを特徴とするコモンレール式燃料噴射装置。

【請求項２】　前記燃料噴射量設定値は、前記コモンレールの燃料圧力と、前記コモンレールの燃料圧力に生じる圧力変化によって検出可能な最少燃料噴射量との間において予め定められた関係に基づいて、前記圧力センサからの検出信号に応じて求められた前記最少燃料噴射量以上の噴射量として算出されることから成る請求項１に記載のコモンレール式燃料噴射装置。

【請求項３】　前記目標副噴射量が前記燃料噴射量設定値よりも小さい場合には、前記目標副噴射量を目標値としたオープンループ制御を行うことから成る請求項１又は２に記載のコモンレール式燃料噴射装置。

【請求項４】　前記インジェクタは、前記コモンレールから供給される燃料の一部が導入される圧力制御室、前記圧力制御室内の燃料の圧力作用に基づいて昇降して前記インジェクタの先端部に形成された燃料を噴射する噴孔を開閉する針弁、前記圧力制御室内の燃料を排出することにより前記圧力制御室内の燃料圧力を解放する開閉弁、及び前記開閉弁を作動させるアクチュエータを具備することから成る請求項１～３のいずれか１項に記載のコモンレール式燃料噴射装置。

【請求項５】　前記コントローラは、前記開閉弁を開弁させるため前記アクチュエータへの駆動信号を制御するコマンドパルスを出力し、前記実副噴射量と前記目標副噴射量との偏差に基づいて、前記コマンドパルスのパルス幅を補正することにより前記副噴射の前記フィードバック制御を行うことから成る請求項４に記載のコモンレール式燃料噴射装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、コモンレール式燃料噴射装置に関し、特に、燃料噴射を主噴射と該主噴射に先行して又は遅延して少量の燃料を噴射する副噴射とで行うコモンレール式燃料噴射装置に関する。

【０００２】

【従来の技術】従来、エンジンの燃料噴射に関して、噴射圧力の高圧化を図り、燃料の噴射タイミング及び噴射量等の噴射条件をエンジンの運転状態に応じて最適に制御する方式として、コモンレール燃料噴射システムが知られている。コモンレール燃料噴射システムは、燃料ポンプによって所定圧力に加圧された燃料をコモンレール内に蓄圧状態で貯留し、貯留された加圧燃料を燃料噴射量及び燃料噴射時期等のエンジンの運転状態に応じてコントローラが求めた最適な燃料噴射条件で複数の気筒にそれぞれ配置された各インジェクタから燃焼室内に噴射するシステムである。コモンレールから燃料供給管を通じて各インジェクタの先端に形成された噴孔に至る燃料流路内には、常時、噴射圧力相当の燃料圧が作用しており、各インジェクタは燃料供給管を通じて供給される燃料を通過又は遮断する制御を行うため電磁弁を備えている。コントローラは、加圧燃料が各インジェクタにおいてエンジンの運転状態に対して最適な噴射条件で噴射されるように、コモンレールの圧力と各インジェクタの電磁弁の作動とを制御している。コモンレール燃料噴射システムには、電磁弁の作動によって高圧燃料の一部を作動流体として利用してインジェクタを作動させる形式のものがある。

【０００３】図５は、コモンレール燃料噴射システムの概要を示す図である。コモンレール燃料噴射システムにおいて、燃料タンク４内の燃料は、フィルタ５及びフィードポンプ６を経た後、燃料管７を通じて、例えばプランジャ式の可変容量式高圧ポンプである燃料ポンプ８に供給される。燃料ポンプ８は、エンジン出力によって駆動されるものであり、燃料を要求される所定圧力に昇圧し、燃料管９を通じてコモンレール２に供給する。燃料ポンプ８には、コモンレール２における燃料圧を所定圧力に維持するため流量制御弁１４が配設されている。燃料ポンプ８からリリーフされた燃料は、戻し管１０を通じて燃料タンク４に戻る。コモンレール２内の燃料は、燃料供給管３を通じて複数のインジェクタ１に供給される。燃料供給管３からインジェクタ１に供給された燃料のうち、燃焼室への噴射に費やされなかった燃料は、戻し管１１を通じて燃料タンク４に戻る。

【０００４】電子制御ユニットであるコントローラ１２には、エンジンの気筒判別センサ、エンジン回転数Ｎｅや上死点（ＴＤＣ）を検出するためのクランク角センサ、アクセルペダル踏込み量Ａｃを検出するためのアク

セル開度センサ、冷却水温度を検出するための水温センサ、吸気管内圧力を検出するための吸気管内圧力センサ等の、エンジンの運転状態を検出するための各種センサからの信号が入力される。コモンレール２には圧力センサ１３が設けられており、圧力センサ１３によって検出されたコモンレール２内の燃料圧力（以下、コモンレール圧力という）の検出信号もコントローラ１２に入力される。コントローラ１２は、これらの信号に基づいて、エンジン出力が運転状態に即した最適出力になるように、インジェクタ１による燃料の噴射条件、即ち、燃料の噴射時期（噴射開始時期と期間）及び噴射量等を制御する。インジェクタ１が燃料を噴射することでコモンレール２内の燃料が消費され、コモンレール内の燃料圧は低下するが、コントローラ１２は、コモンレール２内の燃料圧が一定となるように或いはエンジンの運転状態に応じて必要とされる燃料噴射圧力を得るため、燃料ポンプ８の流量制御弁１４を制御して吐出圧を制御する。図示の例では、エンジンは、６気筒エンジンであるが、４気筒等の他の気筒数であってもよい。

【０００５】図６は、コモンレール式燃料噴射システムに用いられるインジェクタの一例を示す縦断面図である。インジェクタ１は、図示が省略されたシリンダヘッド等のベースに設けられた穴部にシール部材によって密封状態に取付けられる。インジェクタ１の上側側部には燃料入口継手２０を介して燃料供給管３が接続されている。インジェクタ１の本体内部には、燃料通路２１，２２が形成されており、燃料供給管３及び燃料通路２１，２２から燃料流路が構成されている。燃料流路を通じて供給された燃料は、燃料溜まり２３及び針弁２４の周囲の通路を通じて、針弁２４のリフト時に開く噴孔２５から燃焼室内に噴射される。

【０００６】インジェクタ１には、針弁２４のリフトを制御するため、バランスチャンバ式の針弁リフト機構が設けられている。インジェクタ１の最上部には電磁弁を構成する電磁アクチュエータ２６が設けられており、コントローラ１２のコマンドパルスに応じた制御電流が信号線２７を通じて電磁アクチュエータ２６のソレノイド２８に送られる。ソレノイド２８が励磁されると、アーマチュア２９が上昇して燃料路３１の端部に設けられた開閉弁３２を開くので、燃料流路からバランスチャンバ３０に供給された燃料の燃料圧が燃料路３１を通じて解放される。インジェクタ１の本体内部に形成された中空穴３３内には、コントロールピストン３４が昇降可能に設けられている。低下したバランスチャンバ３０内の圧力に基づく力とリターンスプリング３５のばね力とによってコントロールピストン３４に働く押下げ力よりも、燃料溜まり２３に臨むテーパ面３６に作用する燃料圧に基づいてコントロールピストン３４を押し上げる力が勝るため、コントロールピストン３４は上昇する。その結果、針弁２４がリフトし、噴孔２５から燃料が噴射される。燃料噴射時期は針弁２４のリフト時期によって定められ、燃料噴射量は燃料流路内の燃料圧と針弁２４のリフト（リフト量、リフト期間）とによって定められる。

【０００７】一般に、インジェクタ１の燃料噴射量とコントローラ１２が出力するコマンドパルスのパルス幅との関係が、コモンレール圧力Ｐｒ（コモンレール２内の燃料圧力）をパラメータとしたマップによって定められている。コモンレール圧力Ｐｒを一定とすると、パルス幅が大きいほど燃料噴射量は多くなり、また、同じパルス幅であっても、コモンレール圧力Ｐｒが大であるほど燃料噴射量は大きくなる。一方、燃料噴射は、コマンドパルスの立ち下がり時刻と立ち上がり時刻に対して一定時間遅れて開始又は停止されるので、コマンドパルスがオン又はオフとなる時期を制御することによって、噴射タイミングを制御することが可能である。基本噴射量とエンジン回転数との間には、アクセルペダル踏込み量をパラメータとして一定の関係が基本噴射量特性マップとして予め与えられており、燃焼サイクル毎の燃料噴射量は、エンジンの運転状態に応じて基本噴射量特性マップから計算によって求められる。

【０００８】従来より、ディーゼルエンジンにおいて、主噴射に先立って少量の燃料を噴射する、所謂パイロット噴射制御が行われている。パイロット噴射を行うことによって、燃焼室の温度を予め上昇させて噴射された燃料が急激に燃焼することを防止し、その結果、所謂ディーゼルノックが生じるのを防止すると共に排気ガス中に含まれる窒素酸化物の割合を低減することが行われている。また、パイロット噴射量は、パイロット噴射の目的からすると、実験的に求めた窒素酸化物の発生量を考慮して決定される。そうした決定方法で決められたパイロット噴射量では、燃焼が緩慢になり、サージング等の悪影響が生じることもあり得る。パイロット噴射が必要とされるのはエンジンの運転領域が低負荷アイドル運転領域である場合が一般的であるので、パイロット噴射量は、総燃料噴射量に対する比率や一律的な絶対量として求められ、一般的には総噴射量に対する割合も小さく且つ絶対量としても少量である。

【０００９】ところで、インジェクタの噴射特性（特に、噴射時期，噴射量）には、インジェクタ毎に特性が異なる個体バラツキ、及び同じインジェクタであっても時間の経過と共に特性が変化する径年変化があり、コモンレール圧力及びインジェクタを駆動させるためにオンとなるコマンドパルス期間が同一であっても、インジェクタから噴射される燃料噴射量も異なるのが普通である。燃料噴射量それ自体が大きな値であるときには各インジェクタの噴射量に多少の差はあっても大きな問題となることはないが、パイロット噴射の場合のように微小な燃料噴射量で燃料噴射を行うときには個体バラツキ及び径年変化の影響は顕著になり、パイロット噴射として多量の燃料が噴射されたり全く燃料噴射が行われないと

いう事態に至ることがあり得る。パイロット噴射を必要とする低負荷又はアイドル運転時にパイロット噴射が行われる気筒と行われない気筒とが存在すると、燃焼が安定せず、却って車両の運転者に不快感を与えることになる。

【0010】燃料噴射量のバラツキを低減するために、本出願人は、実際の燃料噴射量を燃料噴射時のコモンレール圧力の降下量に基づいて算出し、エンジンの運転状態に基づいて求められる目標燃料噴射量に一致するように、制御量を補正する制御方法を提案している（特願平10－186639号）。この制御方法によれば、燃料噴射直前のコモンレール圧力と、燃料噴射前後におけるコモンレール圧力の降下量とに対応して、マップデータから実際の燃料噴射量を求めることができる。即ち、コモンレール燃料噴射システムにおいてコモンレール圧力を検出するために設けられる圧力センサからの検出信号のデータを利用することによって、実際の燃料噴射量を求めることが提案されている。この制御方法においては、実際の燃料噴射量を求めるに際して、燃料噴射を行うためにインジェクタの圧力制御室から燃料がリークする動的な燃料リーク量が考慮されている。

【0011】ところで、コモンレール圧力の降下量と燃料噴射量との間の関係を示したマップには、コモンレール圧力の降下量からでは実際の燃料噴射量を正確に求めることができない領域がある。図2はコモンレール圧力をパラメータとして燃料噴射量とコモンレール圧力降下量との関係を示したグラフである。図2から分かるように、閾値ΔＰｓ（例えば、１Ｍｐａ）以下のコモンレール圧力の降下量では、グラフ上でコモンレール圧力Ｐｒと燃料噴射量Ｑとの関係が明確でなくなり、コモンレール圧力Ｐｒに応じて実際の燃料噴射量を正確に演算することができない。即ち、図２に示す閾値ΔＰｓ以下のコモンレール圧力の降下量では、実際の燃料噴射量を正確に演算できないので、実際の燃料噴射量を目標燃料噴射量に一致させる燃料噴射量の正確なフィードバック制御も行うことができない。

【0012】

【発明が解決しようとする課題】したがって、燃料噴射を主噴射と主噴射に先行又は遅延して行われる副噴射とで行い、コントローラが副噴射においてインジェクタから燃焼室に噴射されるべき燃料の目標副噴射量を演算し、副噴射において実際に噴射された実副噴射量が目標副噴射量になるように副噴射のフィードバック制御を行うコモンレール式燃料噴射装置においては、副噴射における目標噴射量が、コモンレール圧力の降下量から算出可能な噴射量未満になる場合に、副噴射のフィードバック制御における燃料噴射量の制御量が不安定になるのを回避する必要がある。

【0013】

【課題を解決するための手段】この発明の目的は、高圧燃料ポンプから吐出された燃料を蓄圧状態にコモンレールに貯留し、コモンレールから供給された燃料をインジェクタが燃焼室に噴射し、コントローラがエンジンの運転状態を検出する検出手段からの検出信号に応じて求められる目標燃料噴射量に基づいてインジェクタからの燃料噴射を制御しているコモンレール式燃料噴射装置において、副噴射における目標副噴射量がコモンレール圧力に基づいて検出可能な最少の燃料噴射量よりも少ない噴射量であるときには、副噴射における燃料噴射のフィードバック制御が不安定になるのを回避して、正常な副噴射のフィードバック制御ができなくなることに起因した騒音や排気ガス特性の悪化等を防止することができるコモンレール式燃料噴射装置を提供することである。

【0014】この発明は、高圧燃料ポンプから吐出された燃料を蓄圧状態に貯留するコモンレール、前記コモンレールから供給される燃料を燃焼室に噴射するインジェクタ、エンジンの運転状態を検出する検出手段、前記コモンレールの燃料圧力を検出する圧力センサ、及び前記検出手段からの検出信号に応じて前記インジェクタから噴射すべき燃料の目標噴射量を求め、前記目標噴射量に基づいて前記インジェクタからの燃料噴射を制御するコントローラを具備し、前記コントローラは、前記インジェクタからの前記燃料噴射を前記検出手段からの検出信号に応じて主噴射と該主噴射に先行又は遅延する副噴射とに分割し、目標副噴射量を前記検出手段からの検出信号に応じて算出し、前記コモンレールの前記燃料圧力の降下量に基づいて前記副噴射において実際に噴射された燃料の実副噴射量を算出し、前記実副噴射量が前記目標副噴射量に一致するように前記副噴射のフィードバック制御を行うことから成るコモンレール式燃料噴射装置において、前記コントローラは、前記目標副噴射量と前記圧力センサが検出した前記コモンレールの燃料圧力に対応して求められる燃料噴射量設定値とを比較し、前記目標副噴射量が前記燃料噴射量設定値よりも小さい場合には前記フィードバック制御を停止することを特徴とするコモンレール式燃料噴射装置に関する。

【0015】この発明によるコモンレール式燃料噴射装置によれば、コントローラは、インジェクタからの燃料噴射を、エンジンの運転状態を検出する検出手段からの検出信号に応じて主噴射と該主噴射に先行又は遅延する副噴射とに分割し、コモンレールの燃料圧力を検出する圧力センサからの検出信号に応じて副噴射において噴射すべき燃料の目標総噴射量の一部としての目標副噴射量を算出する。インジェクタから燃料噴射が行われるとコモンレールの燃料圧力が降下するが、目標副噴射量が充分大きな値であり、副噴射において実際に噴射された燃料量である実副噴射量がコモンレールの燃料圧力の降下量に基づいて算出可能であれば、コントローラは、実副噴射量が目標副噴射量に一致するように副噴射のフィードバック制御を行うが、目標副噴射量が実副噴射量を算

出可能とするような充分大きな値でない場合には、不安定に陥り易い副噴射のフィードバック制御を停止して、正常な副噴射のフィードバック制御ができなくなることに起因した騒音や排気ガス特性の悪化等の不具合が防止される。

【0016】前記燃料噴射量設定値は、前記コモンレールの燃料圧力と、前記コモンレールの燃料圧力に生じる圧力変化によって検出可能な最少燃料噴射量との間において予め定められた関係に基づいて、前記圧力センサからの検出信号に応じて求められた前記最少燃料噴射量以上の噴射量として算出される。したがって、目標副噴射量は検出可能な最少燃料噴射量未満に設定されることはなく、そのように設定された目標副噴射量を目標として噴射される実副噴射量は、圧力センサが検出したコモンレールの燃料圧力データから算出可能となり、副噴射のフィードバック制御が不安定になることがない。前記コモンレールの前記燃料圧力と前記最少燃料噴射量との前記関係は、前記燃料噴射の直前における前記コモンレールの前記燃料圧力、前記燃料噴射によって降下した前記コモンレールの前記燃料圧力の降下量、及び前記燃料噴射において噴射された燃料噴射量の関係から、前記コモンレールの前記燃料圧力の検出可能な最少降下量に対応して定められている。具体的には、燃料噴射によって降下したコモンレールの燃料圧力の降下量とその燃料噴射によって噴射された燃料噴射量との関係が、その燃料噴射の直前におけるコモンレールの燃料圧力をパラメータとして、マップデータの形式で予め求められており、圧力センサによって検出可能な燃料圧力の最少降下量に対応して、最少燃料噴射量とコモンレールの燃料圧力との関係が求められる。

【0017】前記目標副噴射量が前記燃料噴射量設定値よりも小さい場合には、前記目標副噴射量を目標値としたオープンループ制御を行う。即ち、目標副噴射量が燃料噴射量設定値よりも小さい場合には、目標副噴射量と実副噴射量との偏差等に基づいて行っていたフィードバック制御に代えて、実副噴射量のフィードバックがないオープンループ制御を行う。

【0018】前記インジェクタは、前記コモンレールから供給される燃料の一部が導入される圧力制御室、前記圧力制御室内の燃料の圧力作用に基づいて昇降して前記インジェクタの先端部に形成された燃料を噴射する噴孔を開閉する針弁、前記圧力制御室内の燃料を排出することにより前記圧力制御室内の燃料圧力を解放する開閉弁、及び前記開閉弁を作動させるアクチュエータを具備している。コントローラがアクチュエータを作動させると、開閉弁が開いて、コモンレールから供給された圧力制御室内の燃料を排出して圧力制御室内の燃料圧力を解放する。圧力制御室内の燃料の圧力が低下することにより、燃料圧力に基づいて針弁が上昇し、インジェクタの先端部に形成された噴孔が開いて燃料を燃焼室に噴射する。

【0019】前記コントローラは、前記開閉弁を開弁させるため前記アクチュエータへの駆動信号を制御するコマンドパルスを出力し、前記実副噴射量と前記目標副噴射量との偏差に基づいて、前記コマンドパルスのパルス幅を補正することにより前記副噴射の前記フィードバック制御を行う。具体的な一制御例としては、同一のインジェクタに対して次回の燃料噴射における目標副噴射量を補正して修正目標副噴射量を求め、修正目標副噴射量に対応するコマンドパルスのパルス幅を変更することにより、インジェクタからの次回の副噴射において実副噴射量が目標副噴射量に一致するように制御される。

【0020】

【発明の実施の形態】以下、図面を参照して、この発明によるコモンレール式燃料噴射装置の実施例を説明する。図1は、図2に示すグラフからコモンレール圧力降下量の閾値、即ち、検出可能な最低のコモンレール圧力降下量に対応したコモンレール圧力と燃料噴射量との関係を示すグラフである。

【0021】コモンレール式燃料噴射システム及びこのシステムに用いられるインジェクタは、それぞれ図5及び図6に示したシステム及びインジェクタをそのまま適用することができる。即ち、インジェクタ1について言えば、コモンレール2から供給される燃料の一部が導入される圧力制御室としてのバランスチャンバ30、バランスチャンバ30内の燃料の圧力作用に基づいて昇降してインジェクタ1の先端部に形成された燃料を噴射する噴孔25を開閉する針弁24、バランスチャンバ30内の燃料を排出することによりバランスチャンバ30内の燃料圧力を解放する開閉弁32、及び開閉弁32を作動させる電磁アクチュエータ26を有している点については、図6に示すインジェクタ1と同様であって良く、その他の細部についての再度の詳細な説明を省略する。

【0022】コモンレール圧力Ｐｒは、エンジンサイクルにおける各気筒毎での燃料噴射に対応して、噴射開始から時間遅れを伴って降下を開始し、噴射終了後には、燃焼順序に従って次に燃焼が行われる気筒での燃料噴射のために高圧燃料ポンプ８からの燃料の吐出に応じて回復するというサイクルを繰り返している。エンジンは、図５に示すように多気筒エンジンであるので、コントローラ１２は、インジェクタ１からの燃料噴射の制御を各気筒別に行っている。

【0023】図１のグラフにおいて、横軸はコモンレールの燃料圧力、即ち、コモンレール圧力Ｐｒであり、縦軸はコモンレール圧力の降下量から検出可能な最少燃料噴射量Ｑ１を示している。図１のグラフに示す曲線ｆは、コモンレール圧力Ｐｒの降下量から検出可能な最少燃料噴射量Ｑ１が、コモンレール圧力Ｐｒの大きさによって変化することを示している。即ち、コモンレール圧力Ｐｒが高いほど小さい値の最少燃料噴射量Ｑ１まで検

出可能であるが、コモンレール圧力Ｐｒが低いほど検出可能な最少燃料噴射量は大きな値となる。図１のグラフから、コモンレール圧力Ｐｒに応じた検出可能な最少燃料噴射量が定められる。

【００２４】図１に示すグラフは、図２に示すグラフから求められる。図２は、この発明によるコモンレール式燃料噴射装置において、燃料噴射量Ｑとコモンレール圧力の降下量ΔＰｒとの関係を、コモンレール２に配設されている圧力センサ１３によって検出されるコモンレール圧力Ｐｒ（噴射直前の値）をパラメータとして描いたグラフである。燃料噴射量Ｑは、インジェクタ１の燃料噴射期間が同じならばコモンレール圧力Ｐｒが高いほど多いが、燃料噴射の直前におけるコモンレール圧力Ｐｒが同じであれば、インジェクタ１からの燃料噴射量Ｑが多いほどコモンレールの圧力降下量ΔＰｒが多くなる。また、同じ燃料噴射量Ｑが噴射されるときコモンレール圧力Ｐｒが高いほどコモンレール圧力の降下量ΔＰｒは大きくなる。コモンレール圧力の降下量ΔＰｒの検出限界として閾値ΔＰｓがあるので、閾値ΔＰｓに応じて求められる最少燃料噴射量Ｑｌはコモンレール圧力Ｐｒに応じて変化することになり、この関係が図１のグラフに表されている。

【００２５】燃料噴射を主噴射と該主噴射に先行又は遅延する副噴射とに分割して行う場合、副噴射の開始直前におけるコモンレール圧力Ｐｒに応じて、目標副噴射量Ｑｔが図１の曲線ｆで定められる最少燃料噴射量Ｑｌ未満として算出されるようなことがあると、副噴射において実際に噴射される燃料の実副噴射量Ｑａが図１の曲線ｆより下の領域の値となり、この場合、実副噴射量Ｑａをコモンレール圧力Ｐｒとその降下量ΔＰｒによって正確に算出することができなくなる。その結果、副噴射のフィードバック制御において燃料噴射量の制御量が不安定になり、燃焼が不安定になることがある。即ち、副噴射が主噴射に先行して行われるパイロット噴射である場合には、本来、噴射量が少ないので、コモンレール圧力Ｐｒの降下量ΔＰｒからでは実際の燃料噴射量を正確に検出することができなくなり、安定したパイロット噴射の制御ができなくなることがある。

【００２６】したがって、エンジンの運転状態に応じて求められる目標副噴射量Ｑｔと、副噴射の開始直前において圧力センサが検出したコモンレール圧力Ｐｒに対応して求められる燃料噴射量の設定値とを比較して、目標副噴射量Ｑｔが燃料噴射量の設定値以上であると、コモンレール圧力Ｐｒの降下量が充分な値となり、コモンレール圧力Ｐｒの降下量から最少燃料噴射量Ｑｌ以上の実副噴射量Ｑａを検出することができ、実副噴射量Ｑａを目標副噴射量Ｑｔに一致させる副噴射における燃料噴射量のフィードバック制御を安定して行うことができる。目標副噴射量Ｑｔが燃料噴射量の設定値よりも小さい場合には、副噴射のフィードバック制御を停止し、例えば、オープンループ制御を行うことができる。燃料噴射量の設定値は、最少燃料噴射量Ｑｌそれ自体でもよいが、最少燃料噴射量Ｑｌに適宜の加算値を加算した値とすることが好ましい。

【００２７】図１に示すグラフは有限個の点のデータよるものであるので、通常は、最少燃料噴射量Ｑｌは、データとして与えられた有限個の点を結ぶ折れ線に基づく補間、或いは有限個の点を結ぶ近似曲線によって求められる。

【００２８】コントローラ１２は、開閉弁３２を開弁させるためアクチュエータ２６への駆動信号を制御するコマンドパルスを出力する。コントローラ１２は、燃料噴射の直前におけるコモンレール圧力Ｐｒ，コマンドパルスのパルス幅及び燃料噴射量の間における予め決められた関係をマップデータとして記憶しており、エンジンの運転状態に応じて求められた副噴射における目標副噴射量Ｑｔと、圧力センサ１３が検出した燃料噴射の直前におけるコモンレール圧力Ｐｒとに応じて求められたコマンドパルスのパルス幅をマップデータから求める。

【００２９】この発明によるコモンレール式燃料噴射装置における燃料噴射制御について、図３～図４に示すフローチャートに基づいて、以下に説明する。図３は、この発明によるコモンレール式燃料噴射装置における燃料噴射制御のメインルーチンを示すフローチャートである。ここでは、エンジンの運転状態を検出する検出手段として、エンジン回転数Ｎｅを検出するエンジン回転数センサと、エンジンへの負荷を表すものとしてアクセルペダル踏込み量のようなアクセル操作量Ａｃを検出するアクセル操作量センサがある。図３に示すように、エンジンの運転状態として、エンジン回転数Ｎｅがエンジン回転数センサによって検出され（ステップ１）、アクセル操作量Ａｃがアクセル操作量センサによって検出される（ステップ２）。ステップ１及びステップ２で検出されたエンジン回転数Ｎｅとアクセル操作量Ａｃとに基づいて、予め決められたマップデータ（図示せず）を参照することにより、目標副噴射量Ｑｔ及び目標副噴射時期Ｔが求められる（ステップ３、ステップ４）。コモンレール圧力Ｐｒが圧力センサ１３のサンプリング検出信号から算出される（ステップ５）。ステップ３で求められた目標副噴射量Ｑｔを得るために必要な目標コモンレール圧力Pr_0が決定される（ステップ６）。高圧燃料ポンプ８の流量制御弁１４の開閉を定める割合（例えば、電磁弁のデューティ比）を制御することにより、コモンレール圧力Ｐｒが目標コモンレール圧力Pr_0となるように制御される（ステップ７）。

【００３０】図４は、副噴射における補正制御ルーチンを示すフローチャートである。圧力センサ１３によってサンプリング検出されたコモンレール圧力Ｐｒから、適宜の平滑化処理を経て、各気筒の副噴射の直前におけるコモンレール圧力Ｐｒｈと、副噴射終了直後におけるコ

モンレール圧力Ｐｒｌが求められ、コントローラ１２のメモリに記憶されている。先ず、コントローラ１２のメモリから副噴射の直前及び直後におけるコモンレール圧力ＰｒｈとＰｒｌとが読み出される（ステップ１０）。副噴射前のコモンレール圧力Ｐｒｈと、副噴射によって降下したコモンレール圧力の降下量ΔＰｒ（＝Ｐｒｈ－Ｐｒｌ）が求められる（ステップ１１）。副噴射前のコモンレール圧力Ｐｒｈ及びコモンレール圧力の降下量ΔＰｒから、副噴射において噴射された燃料の実副噴射量Ｑａが、図２に示すマップデータから算出され（ステップ１２）、ステップ３で求められた目標副噴射量Ｑｔが読み込まれる（ステップ１３）。図１においてコモンレール圧力Ｐｒと検出可能な最少燃料噴射量Ｑｌとの間における予め定められた関係を示すグラフ（マップデータ）に基づいて、副噴射の直前におけるコモンレール圧力Ｐｒｈに対応した燃料噴射量設定値Ｑｓ、即ち、この例では、最少燃料噴射量Ｑｌを算出する（ステップ１４）。なお、燃料噴射量設定値Ｑｓは、既に説明したように、最少燃料噴射量Ｑｌよりも僅かに大きい値とすることもできる。

【００３１】ステップ１３で読み込まれた目標副噴射量Ｑｔとステップ１４で算出された最少燃料噴射量Ｑｌとが比較される（ステップ１５）。目標副噴射量Ｑｔが最少燃料噴射量Ｑｌ以上である場合には、前回の燃料噴射時における本ルーチンの実行の際に，ステップ１３で読み込まれた目標副噴射量Ｑｔ’と目標副噴射量Ｑｔ’に基づいて噴射された実副噴射量Ｑａ（ステップ１２で算出）とを用いて、補正係数Ｋ（Ｋ＝Ｑｔ’／Ｑａ）が求められる（ステップ１６）。補正係数Ｋを用いたフィードバック制御によって目標副噴射量Ｑｔが補正され、修正目標副噴射量Ｑｃ（Ｑｃ＝Ｋ×Ｑｔ）が求められる（ステップ１７）。修正目標副噴射量Ｑｃに対応したコマンドパルス幅をマップデータから算出する（ステップ１８）。コマンドパルス幅に応じた駆動信号がインジェクタ１の電磁アクチュエータ２６に供給され、インジェクタ１から燃料が噴射される（ステップ１９）。

【００３２】ステップ１５の比較において、目標副噴射量Ｑｔが最少燃料噴射量Ｑｌ未満である場合は、修正目標副噴射量Ｑｃには目標副噴射量Ｑｔが設定され、以下、設定された修正目標副噴射量Ｑｃに応じてステップ１９及びステップ２０が実行される。

【００３３】今回の燃料噴射における副噴射の目標副噴射量の補正において、今回の実副噴射量Ｑａに対する前回の目標副噴射量Ｑｔ’の比（Ｑｔ’／Ｑａ）として求めた補正係数を用いた例を示したが、今回の実副噴射量Ｑａと前記の目標副噴射量Ｑｔ’との偏差ΔＱ（Ｑａ－Ｑｔ’）に基づいて今回の副噴射量を補正してもよい。即ち、同一のインジェクタ１に対して偏差ΔＱに応じて今回の燃焼サイクルにおける目標副噴射量Ｑｔを補正して修正目標副噴射量Ｑｃを求め、修正目標副噴射量Ｑｃに対応したコマンドパルスのパルス幅を変更するか、又は偏差ΔＱに応じてコマンドパルスのパルス幅の補正量を求めてもよい。

【００３４】

【発明の効果】この発明によるコモンレール式燃料噴射装置によれば、高圧燃料ポンプから吐出された燃料は蓄圧状態にコモンレールに貯留され、コモンレールから供給された燃料がインジェクタから燃焼室に噴射され、コントローラは、エンジンの運転状態を検出する検出手段からの検出信号に応じて求められる目標燃料噴射量に基づいてインジェクタからの燃料噴射を制御しており、副噴射における目標副噴射量がコモンレール圧力に基づいて求められる燃料噴射量設定値よりも小さいときにはフィードバック制御を停止しているので、副噴射における燃料噴射のフィードバック制御が不安定になることがない。したがって、各インジェクタの個体差、或いは同じインジェクタであってもその噴射特性の径時変化に起因した振動・騒音や排気ガス特性の悪化等の不具合が生じるのを防止することができる。なお、この発明による燃料噴射制御は、常時行うのではなく、一時期の学習や個々のインジェクタにおける経時劣化の有無の判断に使用することもできる。

【図面の簡単な説明】

【図１】この発明によるコモンレール式燃料噴射装置において、コモンレール圧力とその検出限界から求められる最少燃料噴射量との関係を示すグラフである。

【図２】この発明によるコモンレール式燃料噴射装置において、コモンレール圧力をパラメータとした燃料噴射量とコモンレール圧力の降下量との関係を示すグラフである。

【図３】この発明によるコモンレール式燃料噴射装置における、副噴射制御のメインルーチンを示すフローチャートである。

【図４】この発明によるコモンレール式燃料噴射装置における、副噴射制御の補正制御ルーチンを示すフローチャートである。

【図５】従来のコモンレール式燃料噴射システムを示す概略図である。

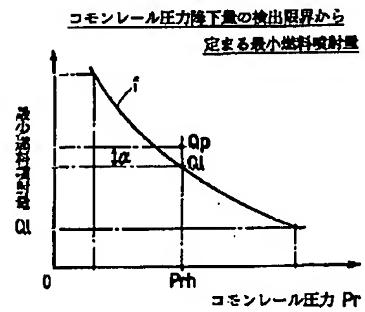
【図６】図５に示すコモンレール式燃料噴射システムに用いられるインジェクタの一例を示す断面図である。

【符号の説明】

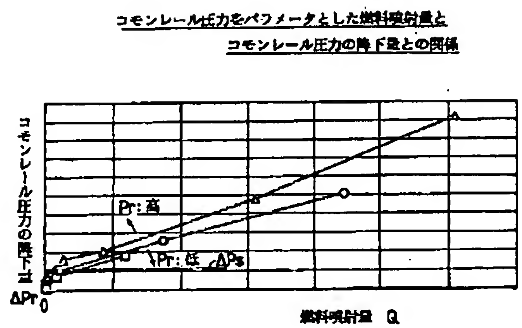
１　　インジェクタ
２　　コモンレール
３　　燃料供給管
８　　燃料供給ポンプ
１２　コントローラ
１３　圧力センサ
２４　針弁
２５　噴孔
２６　電磁アクチュエータ

３０　バランスチャンバ
３２　開閉弁
Ｐｒ　　コモンレール圧力
ΔＰｒ　コモンレール圧力の降下量
ΔＰｓ　コモンレール圧力の降下量の閾値
Ｑｔ　　目標副噴射量
Ｑｔ’　前回の目標副噴射量
Ｑａ　　実副噴射量
Ｑｓ　　燃料噴射量設定値
Ｑｌ　　最少燃料噴射量
Ｑｃ　　修正目標副噴射量
Ｋ　　　補正係数

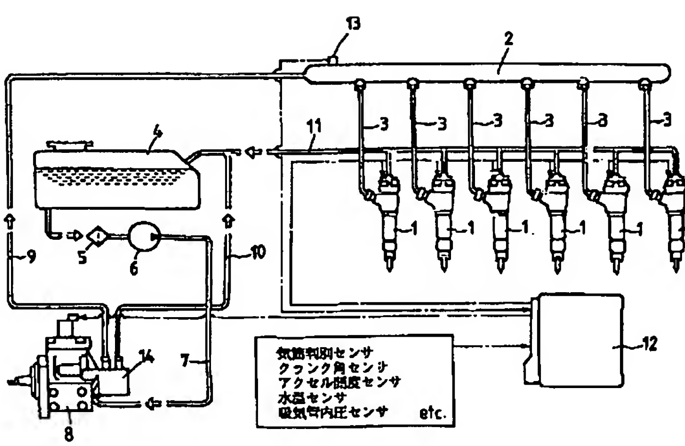
【図１】



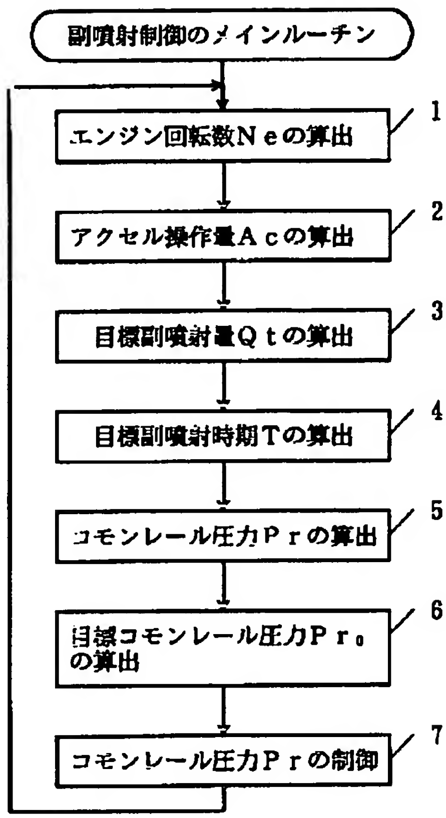
【図２】



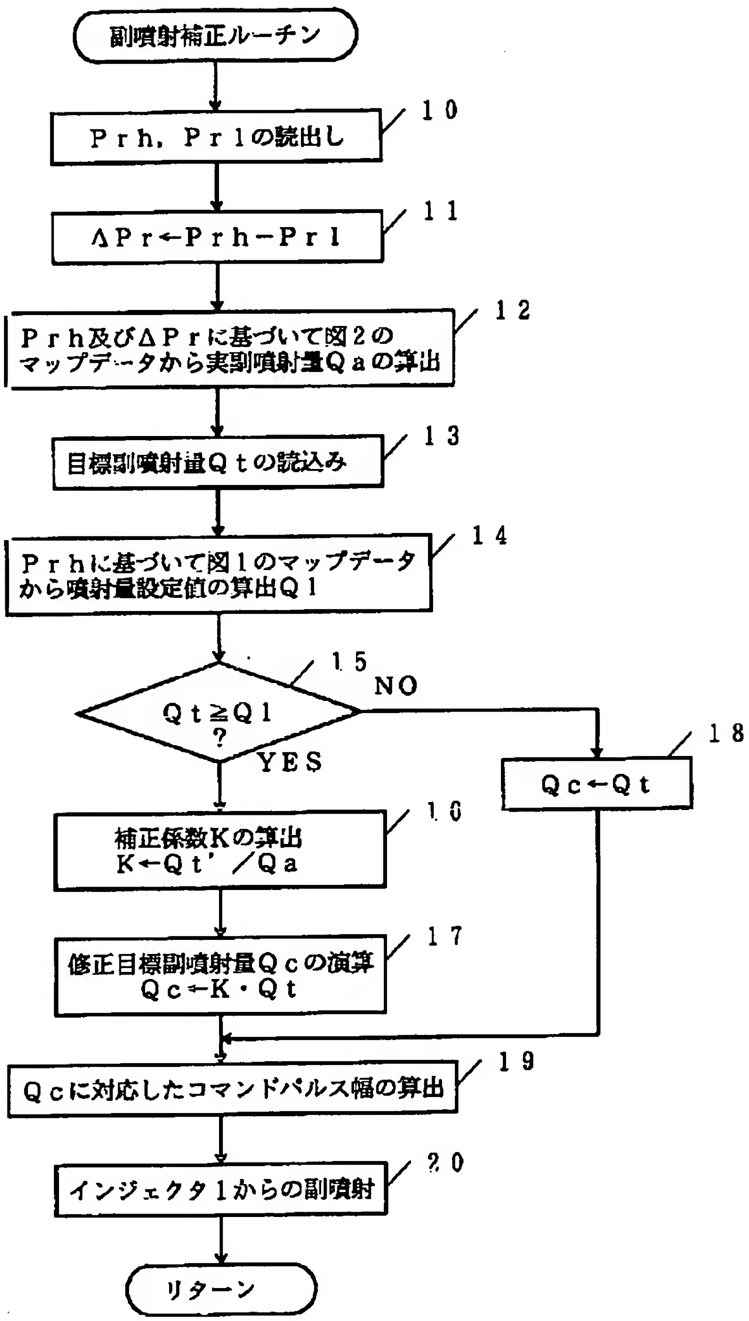
【図５】



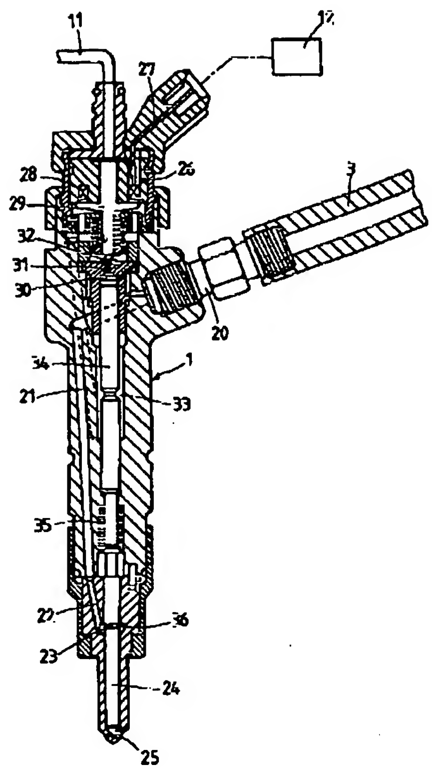
【図3】


副噴射制御のメインルーチン
エンジン回転数Neの算出
1
アクセル操作量Acの算出
2
目標副噴射量Qtの算出
3
目標副噴射時期Tの算出
4
コモンレール圧力Prの算出
5
目標コモンレール圧力Pr0の算出
6
コモンレール圧力Prの制御
7

【図4】



【図6】



フロントページの続き

(51)Int.Cl.7	識別記号	ＦＩ	(参考)
ＦＯ２Ｍ 47/00		ＦＯ２Ｍ 47/00 Ｅ	
55/02	３５０	55/02 ３５０Ｅ	

Ｆターム(参考) 3G060 BA02 CA01 DA08 DA12 GA03
GA04 GA14
3G066 AA02 AA07 AC09 BA22 BA31
BA43 CD03 DA01 DA09 DC04
DC09 DC18
3G301 HA02 HA04 JA14 JA15 JA17
JA21 JA37 LB04 MA14 MA23
MA26 NA08 ND01 ND15 ND41
PB03A PB03Z PB08A PB08Z
PE01Z PF03Z

CLAIMS

[Claim(s)]
[Claim 1] The common rail which stores in a pressure accumulation condition the fuel breathed out from the high-pressure fuel pump, The injector which injects the fuel supplied from said common rail to a combustion chamber, A detection means to detect engine operational status, the pressure sensor which detects the fuel pressure of said common rail, And the target injection quantity of the fuel which should be injected from said injector according to the detecting signal from said detection means is calculated. The controller which controls the fuel injection from said injector based on said target injection quantity is provided. Said controller Said fuel injection from said injector is divided into the subinjection which responds to a detecting signal from said detection means, and is preceded or delayed to the main injection and this main injection. According to the detecting signal from said detection means, compute the target secondary injection quantity, and the **** injection quantity of the fuel actually injected in said subinjection based on the amount of descent of said fuel pressure of said common rail is computed. In the common rail type fuel injection equipment which consists of performing feedback control of said subinjection so that said **** injection quantity may be in agreement with said target secondary injection quantity said controller The fuel-oil-consumption set point calculated corresponding to the fuel pressure of said common rail which said target secondary injection quantity and said pressure sensor detected is compared. The common rail type fuel injection equipment characterized by suspending said feedback control when said target secondary injection quantity is smaller than said fuel-oil-consumption set point.
[Claim 2] Said fuel-oil-consumption set point is a common rail type fuel injection equipment according to claim 1 which consists of being computed based on the relation beforehand defined between the minimum fuel oil consumption detectable [with the pressure variation produced in the fuel pressure of said common rail, and the fuel pressure of said common rail] as injection quantity more than said minimum fuel oil consumption calculated according to the detecting signal from said pressure sensor.
[Claim 3] The common rail type fuel injection equipment according to claim 1 or 2 which consists of performing open loop control which made said target secondary injection quantity desired value when said target secondary injection quantity is smaller than said fuel-oil-consumption set point.
[Claim 4] The pressure control room where some fuels with which said injector is supplied from said common rail are introduced, The needle valve which opens and closes the nozzle hole which injects the fuel which went up and down based on the pressure operation of the fuel in said pressure control room, and was formed in the point of said injector, A common rail type fuel injection equipment given in any 1 term of claims 1-3 which consist of providing the actuator which operates the closing motion valve which releases the fuel pressure in said pressure control room by discharging the fuel in said pressure control room, and said closing motion valve.
[Claim 5] Said controller is a common rail type fuel injection equipment according to claim 4 which consists of performing said feedback control of said subinjection by outputting the command pulse which controls the driving signal to said actuator, in order to make said closing motion valve open, and amending the pulse width of said command pulse based on the deflection of said **** injection quantity

and said target secondary injection quantity.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the common rail type fuel injection equipment performed by the subinjection which precedes fuel injection with the main injection and this main injection, or is delayed about a common rail type fuel injection equipment, and injects a little fuel.
[0002]
[Description of the Prior Art] Conventionally, about engine fuel injection, high-pressure-ization of an injection pressure is attained and the common rail fuel-injection system is known as a method which controls injection conditions, such as injection timing of a fuel, and injection quantity, the optimal according to engine operational status. A common rail fuel-injection system is a system injected to a combustion chamber from each injector arranged at two or more gas columns on the optimal fuel-injection conditions which the fuel pressurized by the predetermined pressure was stored in the state of pressure accumulation in the common rail, and the controller asked for the stored pressurization fuel according to the operational status of engines, such as fuel oil consumption and fuel injection timing, with the fuel pump, respectively. In the fuel passage which results in the nozzle hole formed at the tip of each injector through the fuel feeding pipe from the common rail, the fuel pressure of an injection pressure is acting, and each injector is always equipped with the solenoid valve in order to perform control which passes or intercepts the fuel supplied through a fuel feeding pipe. The controller is controlling the pressure of a common rail, and actuation of the solenoid valve of each injector so that a pressurization fuel is injected on the optimal injection conditions to engine operational status in each injector. There is a thing of a format which operates an injector as a working fluid by actuation of a solenoid valve using some high-pressure fuels in a common rail fuel-injection system.
[0003] Drawing 5 is drawing showing the outline of a common rail fuel-injection system. In a common rail fuel-injection system, after the fuel in a fuel tank 4 passes through a filter 5 and a feed pump 6, it is supplied to the fuel pump 8 which is plunger-type variable-capacity type high pressure pumping through a fuel pipe 7. A fuel pump 8 is driven by engine power, carries out a pressure up to the predetermined pressure of which a fuel is required, and is supplied to a common rail 2 through a fuel pipe 9. In order to maintain the fuel pressure in a common rail 2 to a predetermined pressure, the flow control valve 14 is arranged by the fuel pump 8. The fuel relieved from the fuel pump 8 returns to a fuel tank 4 through the return tubing 10. The fuel in a common rail 2 is supplied to two or more injectors 1 through a fuel feeding pipe 3. The fuel which was not spent on the injection to a combustion chamber among the fuels supplied to the injector 1 from the fuel feeding pipe 3 returns to a fuel tank 4 through the return tubing 11.
[0004] The signal from the various sensors for detecting engine operational status, such as a pressure sensor of inhalation of air for detecting the coolant temperature sensor for detecting the accelerator opening sensor for detecting the crank angle sensor for detecting a gas column distinction sensor, an engine engine speed Ne, and an engine top dead center (TDC) and the amount Ac of accelerator pedal treading in and a circulating water temperature and the pressure of inhalation of air, is inputted into the

controller 12 which is an electronic control unit. The pressure sensor 13 is formed in the common rail 2, and the detecting signal of the fuel pressure in the common rail 2 detected by the pressure sensor 13 (henceforth the common-rail-pressure force) is also inputted into a controller 12. A controller 12 controls fuel injection timing (the injection initiation stage and period), injection quantity, etc. of the injection conditions of the fuel by the injector 1, i.e., a fuel, so that engine power turns into the optimal output adapted to operational status based on these signals. Although the fuel in a common rail 2 is consumed because an injector 1 injects a fuel, and the fuel pressure in a common rail falls, in order that a controller 12 may obtain the fuel injection pressure needed according to engine operational status so that the fuel pressure in a common rail 2 may become fixed or, it controls the flow control valve 14 of a fuel pump 8, and controls a discharge pressure. In the example of illustration, although an engine is a six cylinder engine, they may be other numbers of gas columns, such as a 4-cylinder.
[0005] Drawing 6 is drawing of longitudinal section showing an example of the injector used for a common rail type fuel-injection system. An injector 1 is attached in the hole prepared in the bases, such as the cylinder head to which illustration was abbreviated, by the seal member at a seal condition. The fuel feeding pipe 3 is connected to the top flank of an injector 1 through the fuel inlet-port joint 20. The fuel paths 21 and 22 are formed in the interior of the body of an injector 1, and fuel passage consists of a fuel feeding pipe 3 and fuel paths 21 and 22. The fuel supplied through fuel passage is injected by the combustion chamber through the path around the reserve-well ball 23 and a needle valve 24 from the nozzle hole 25 opened at the time of the lift of a needle valve 24.
[0006] In order to control the lift of a needle valve 24, the needle-valve lift device of a balance chamber type is prepared in the injector 1. the electromagnetism which constitutes a solenoid valve in the topmost part of an injector 1 -- the control current the actuator 26 is formed and corresponding to the command pulse of a controller 12 -- a signal line 27 -- leading -- electromagnetism -- it is sent to the solenoid 28 of an actuator 26. If a solenoid 28 is excited, since the closing motion valve 32 which the armature 29 went up and was prepared in the edge of the fuel way 31 will be opened, the fuel pressure of the fuel supplied to the balance chamber 30 is released from fuel passage through the fuel way 31. In the hollow hole 33 formed in the interior of the body of an injector 1, the control piston 34 is formed possible [rise and fall]. Since the force which pushes up a control piston 34 rather than the push-down force committed to a control piston 34 based on the fuel pressure which acts on the taper side 36 which attends the reserve-well ball 23 according to the force and the spring force of a return spring 35 based on the pressure in the lowered balance chamber 30 excels, a control piston 34 goes up. Consequently, a needle valve 24 carries out a lift and a fuel is injected from a nozzle hole 25. Fuel injection timing is set by the lift stage of a needle valve 24, and fuel oil consumption is defined by the fuel pressure in fuel passage, and the lift (the amount of lifts, lift period) of a needle valve 24.
[0007] Generally, the relation between the fuel oil consumption of an injector 1 and the pulse width of the command pulse which a controller 12 outputs is defined on the map which made the parameter the common-rail-pressure force Pr (fuel pressure in a common rail 2). If the common-rail-pressure force Pr is set constant, even if fuel oil consumption increases and it is the same pulse width so that pulse width is large, fuel oil consumption will become large, so that the common-rail-pressure force Pr is size. On the other hand, since it starts with the falling time of day of a command pulse, and it is fixed-time-behind to time of day and is started or stopped, fuel injection can control injection timing, when a command pulse controls ON or the stage to become off. Between the basic injection quantity and an engine speed, the amount of accelerator pedal treading in is beforehand given to relation fixed as a parameter as a basic characteristics-of-spray-amount map, and the fuel oil consumption for every combustion cycle is calculated by count from a basic characteristics-of-spray-amount map according to engine operational status.
[0008] Conventionally, in the diesel power plant, the so-called pilot injection control which injects a little fuel in advance of the main injection is performed. While preventing that prevent that the fuel which the temperature of a combustion chamber was raised beforehand and injected by performing pilot injection burns rapidly, consequently the so-called diesel knock arises, reducing the rate of the nitrogen oxides contained in exhaust gas is performed. Moreover, the pilot injection quantity is determined in

consideration of the yield of the nitrogen oxides for which it asked experimentally, considering the purpose of pilot injection. In the pilot injection quantity decided by such decision approach, combustion becomes slow and bad influences, such as a surging, may arise. Since that pilot injection is needed has the common case where an engine operating range is a low loading idle operating range, the pilot injection quantity is calculated as the ratio to the total fuel oil consumption, or uniform absolute magnitude, and, generally its rate to the total injection quantity is also small little also as absolute magnitude.

[0009] By the way, in order for there to be path yearly change from which a property changes with the passage of time in the injection property (especially fuel injection timing, injection quantity) of an injector even if it is the individual variation from which a property differs for every injector, and the same injector, and to make the common-rail-pressure force and an injector drive, even if the command pulse period used as ON is the same, usually the fuel oil consumption injected from an injector also differs. Although it does not become a big problem even if some differences are in the injection quantity of each injector, when fuel-oil-consumption itself is a big value, when performing fuel injection with minute fuel oil consumption like [in pilot injection], the effect of individual variation and path yearly change becomes remarkable, and it may result in the situation where a lot of fuels as pilot injection are not injected, or fuel injection is not performed at all. When the gas column in which pilot injection is performed at the time of the low loading which needs pilot injection, or idle operation, and the gas column which is not performed exist, combustion will not be stabilized but displeasure will be given to the operator of a car on the contrary.

[0010] In order to reduce the variation in fuel oil consumption, these people computed actual fuel oil consumption based on the amount of descent of the common-rail-pressure force at the time of fuel injection, and they have proposed the control approach which amends a controlled variable so that it may be in agreement with the target fuel oil consumption calculated based on engine operational status (Japanese Patent Application No. No. 186639 [ten to]). According to this control approach, corresponding to the amount of descent of the common-rail-pressure force in front of fuel injection, and the common-rail-pressure force before and behind fuel injection, actual fuel oil consumption can be calculated from map data. That is, calculating actual fuel oil consumption is proposed by using the data of the detecting signal from the pressure sensor formed in order to detect the common-rail-pressure force in a common rail fuel-injection system. In this control approach, it faces in quest of actual fuel oil consumption, and in order to perform fuel injection, the dynamic amount of fuel leaks which a fuel leaks from the pressure control room of an injector is taken into consideration.

[0011] By the way, there is a field which cannot calculate actual fuel oil consumption correctly in the map in which the relation between the amount of descent of the common-rail-pressure force and fuel oil consumption was shown from the amount of descent of the common-rail-pressure force. Drawing 2 is the graph which showed the relation between fuel oil consumption and the amount of common-rail-pressure force descent by making the common-rail-pressure force into a parameter. In the amount of descent of the common-rail-pressure force below threshold deltaPs (for example, 1Mpa), the relation between the common-rail-pressure force Pr and fuel oil consumption Q becomes less clear on a graph, and actual fuel oil consumption cannot be correctly calculated according to the common-rail-pressure force Pr so that drawing 2 may show. That is, in the amount of descent of the common-rail-pressure force below threshold deltaPs shown in drawing 2 , since actual fuel oil consumption cannot be calculated correctly, feedback control with the exact fuel oil consumption which makes actual fuel oil consumption in agreement with target fuel oil consumption cannot be performed, either.

[0012]

[Problem(s) to be Solved by the Invention] Therefore, fuel injection is performed by the subinjection carried out to the main injection and the main injection by being preceded or delayed. The target secondary injection quantity of the fuel with which a controller should be injected by the combustion chamber from an injector in subinjection is calculated. In the common rail type fuel injection equipment which performs feedback control of subinjection so that the **** injection quantity actually injected in subinjection may turn into target secondary injection quantity When the target injection quantity in

subinjection turns into under the injection quantity computable from the amount of descent of the common-rail-pressure force, it is necessary to avoid that the controlled variable of the fuel oil consumption in the feedback control of subinjection becomes unstable.
[0013]
[Means for Solving the Problem] The purpose of this invention stores in a pressure accumulation condition the fuel breathed out from the high-pressure fuel pump at a common rail. An injector injects the fuel supplied from the common rail to a combustion chamber. In the common rail type fuel injection equipment which is controlling the fuel injection from an injector based on the target fuel oil consumption asked for a controller according to the detecting signal from a detection means which detects engine operational status When the target secondary injection quantity in subinjection is injection quantity smaller than the minimum detectable fuel oil consumption based on the common-rail-pressure force It is offering the common rail type fuel injection equipment which can prevent the noise resulting from avoiding the feedback control of the fuel injection in subinjection becoming unstable, and becoming impossible as for the feedback control of normal subinjection, aggravation of an exhaust gas property, etc.
[0014] The common rail which stores in a pressure accumulation condition the fuel with which this invention was breathed out from the high-pressure fuel pump, The injector which injects the fuel supplied from said common rail to a combustion chamber, A detection means to detect engine operational status, the pressure sensor which detects the fuel pressure of said common rail, And the target injection quantity of the fuel which should be injected from said injector according to the detecting signal from said detection means is calculated. The controller which controls the fuel injection from said injector based on said target injection quantity is provided. Said controller Said fuel injection from said injector is divided into the subinjection which responds to a detecting signal from said detection means, and is preceded or delayed to the main injection and this main injection. According to the detecting signal from said detection means, compute the target secondary injection quantity, and the **** injection quantity of the fuel actually injected in said subinjection based on the amount of descent of said fuel pressure of said common rail is computed. In the common rail type fuel injection equipment which consists of performing feedback control of said subinjection so that said **** injection quantity may be in agreement with said target secondary injection quantity said controller The fuel-oil-consumption set point calculated corresponding to the fuel pressure of said common rail which said target secondary injection quantity and said pressure sensor detected is compared. When said target secondary injection quantity is smaller than said fuel-oil-consumption set point, it is related with the common rail type fuel injection equipment characterized by suspending said feedback control.
[0015] According to the common rail type fuel injection equipment by this invention, a controller divides the fuel injection from an injector into the subinjection which responds to the detecting signal which detects engine operational status from a detection means, and is preceded or delayed to the main injection and this main injection, and computes the target secondary injection quantity as a part of target total injection quantity of the fuel which should be injected in subinjection according to the detecting signal from a pressure sensor which detects the fuel pressure of a common rail. Although the fuel pressure of a common rail will descend if fuel injection is performed from an injector Although a controller will perform feedback control of subinjection so that the **** injection quantity may be in agreement with the target secondary injection quantity if the **** injection quantity which the target secondary injection quantity is a sufficiently big value, and is the fuel quantity actually injected in subinjection is computable based on the amount of descent of the fuel pressure of a common rail When it is not sufficient big value whose calculation of the **** injection quantity the target secondary injection quantity enables, the feedback control of the subinjection which is easy to fall unstably is suspended, and faults resulting from the feedback control of normal subinjection becoming impossible, such as noise and aggravation of an exhaust gas property, are prevented.
[0016] Said fuel-oil-consumption set point is computed based on the relation beforehand defined between the minimum fuel oil consumption detectable [with the pressure variation produced in the fuel pressure of said common rail, and the fuel pressure of said common rail] as injection quantity more than

said minimum fuel oil consumption calculated according to the detecting signal from said pressure sensor. Therefore, the **** injection quantity injected for the purpose of the target secondary injection quantity which the target secondary injection quantity is not set under to the detectable minimum fuel oil consumption, and was set up such becomes computable from the fuel pressure data of the common rail which the pressure sensor detected, and the feedback control of subinjection does not become unstable. Said relation between said fuel pressure of said common rail and said minimum fuel oil consumption is defined corresponding to the amount of the minimum descent which can detect said fuel pressure of said common rail from the relation of the amount of descent of said fuel pressure of said common rail in front of said fuel injection, and said fuel pressure of said common rail which descended by said fuel injection, and the fuel oil consumption injected in said fuel injection. The relation between the amount of descent of the fuel pressure of the common rail which descended by fuel injection, and the fuel oil consumption injected by the fuel injection is specifically beforehand called for in the form of map data by making fuel pressure of the common rail in front of the fuel injection into a parameter, and the relation between the minimum fuel oil consumption and the fuel pressure of a common rail is called for corresponding to the amount of the minimum descent of fuel pressure detectable [with a pressure sensor].

[0017] When said target secondary injection quantity is smaller than said fuel-oil-consumption set point, open loop control which made said target secondary injection quantity desired value is performed. That is, when the target secondary injection quantity is smaller than the fuel-oil-consumption set point, it replaces with the feedback control which was being performed based on the deflection of the target secondary injection quantity and the **** injection quantity etc., and open loop control without feedback of the **** injection quantity is performed.

[0018] Said injector possesses the actuator which operates the needle valve which opens and closes the nozzle hole which injects the fuel which went up and down based on the pressure operation of the fuel in the pressure control room where some fuels supplied from said common rail are introduced, and said pressure control room, and was formed in the point of said injector, the closing-motion valve which releases the fuel pressure in said pressure control room by discharging the fuel in said pressure control room, and said closing-motion valve. If a controller operates an actuator, a closing motion valve will open, the fuel in the pressure control room supplied from the common rail will be discharged, and the fuel pressure in pressure control room will be released. When the pressure of the fuel in pressure control room declines, a needle valve goes up based on fuel pressure, the nozzle hole formed in the point of an injector opens, and a fuel is injected to a combustion chamber.

[0019] Said controller outputs the command pulse which controls the driving signal to said actuator in order to make said closing motion valve open, and it performs said feedback control of said subinjection by amending the pulse width of said command pulse based on the deflection of said **** injection quantity and said target secondary injection quantity. By amending the target secondary injection quantity in next fuel injection to the same injector as a concrete example of 1 control, calculating the correction target secondary injection quantity, and changing the pulse width of the command pulse corresponding to the correction target secondary injection quantity, it is controlled so that the **** injection quantity is in agreement with the target secondary injection quantity in subinjection of the next time from an injector.

[0020]

[Embodiment of the Invention] Hereafter, with reference to a drawing, the example of the common rail type fuel injection equipment by this invention is explained. Drawing 1 is a graph which shows the relation of the common-rail-pressure force and fuel oil consumption corresponding to the threshold of common-rail-pressure force descent of the amount of common-rail-pressure force descent, i.e., the minimum detectable amount, from the graph shown in drawing 2 .

[0021] The injector used for a common rail type fuel-injection system and this system can apply the system and injector which were shown in drawing 5 and drawing 6 , respectively as it is. namely, speaking of an injector 1 As pressure control room where some fuels supplied from a common rail 2 are introduced It goes up and down based on a pressure operation of the fuel in the ** balance chamber 30

and a balance chamber 30. By discharging the fuel in the needle valve 24 which opens and closes the nozzle hole 25 which injects the fuel formed in the point of an injector 1, and a balance chamber 30 the electromagnetism which operates the closing motion valve 32 which releases the fuel pressure in a balance chamber 30, and the closing motion valve 32 -- about the point of having the actuator 26, you may be the same as that of the injector 1 shown in drawing 6 , and the detailed explanation for the second time about other details is omitted.
[0022] Corresponding to the fuel injection of every [in an engine cycle] gas column, the common-rail-pressure force Pr started descent with the time lag from injection initiation, and has repeated the cycle of recovering according to the regurgitation of the fuel from the high-pressure fuel pump 8 for the fuel injection in the gas column in which combustion is performed next according to combustion sequence, after injection termination. Since an engine is a multiple cylinder engine as shown in drawing 5 , the controller 12 is controlling fuel injection from an injector 1 according to each gas column.
[0023] In the graph of drawing 1 , an axis of abscissa is the fuel pressure Pr of a common rail, i.e., the common-rail-pressure force, and the axis of ordinate shows the minimum fuel oil consumption Ql detectable from the amount of descent of the common-rail-pressure force. The curve f shown in the graph of drawing 1 shows that the minimum fuel oil consumption Ql detectable from the amount of descent of the common-rail-pressure force Pr changes with the magnitude of the common-rail-pressure force Pr. That is, although it is detectable to the minimum fuel oil consumption Ql of such a small value that the common-rail-pressure force Pr is high, the minimum fuel oil consumption detectable, so that the common-rail-pressure force Pr is low serves as a big value. From the graph of drawing 1 , the detectable minimum fuel oil consumption according to the common-rail-pressure force Pr is defined.
[0024] The graph shown in drawing 1 is called for from the graph shown in drawing 2 . Drawing 2 is the graph which drew as a parameter the common-rail-pressure force Pr (value in front of injection) detected by the pressure sensor 13 currently arranged by the common rail 2 in the relation between fuel oil consumption Q and amount of descent deltaPr of the common-rail-pressure force in the common rail type fuel injection equipment by this invention. Although many [so / that the common-rail-pressure force Pr is high if fuel oil consumption Q has the the same fuel fuel injection period of an injector 1], if the common-rail-pressure force Pr in front of fuel injection is the same, amount of pressure drawdowns deltaPr of a common rail will increase, so that there is much fuel oil consumption Q from an injector 1. Moreover, amount of descent deltaPr of the common-rail-pressure force becomes large, so that the common-rail-pressure force Pr is high, when the same fuel oil consumption Q is injected. Since there is threshold deltaPs as limit of detection of amount of descent deltaPr of the common-rail-pressure force, the minimum fuel oil consumption Ql calculated according to threshold deltaPs will change according to the common-rail-pressure force Pr, and this relation is expressed with the graph of drawing 1 .
[0025] When fuel injection is divided into the main injection and the subinjection preceded or delayed to this main injection and is performed, If it seems that it may be computed according to the common-rail-pressure force Pr in front of initiation of subinjection as under the minimum fuel oil consumption Ql as which the target secondary injection quantity Qt is determined with the curve f of drawing 1 The **** injection quantity Qa of the fuel actually injected in subinjection serves as a value of the field below the curve f of drawing 1 , and it becomes impossible to compute the **** injection quantity Qa correctly in this case by the common-rail-pressure force Pr and its amount of descent deltaPr. Consequently, in the feedback control of subinjection, the controlled variable of fuel oil consumption may become unstable, and combustion may become unstable. That is, originally, when it is the pilot injection to which subinjection precedes with the main injection and is performed, since there is little injection quantity, control of the pilot injection which it becomes impossible to have detected actual fuel oil consumption correctly, and was stabilized becomes impossible from amount of descent deltaPr of the common-rail-pressure force Pr.
[0026] Therefore, the target secondary injection quantity Qt calculated according to engine operational status The set point of the fuel oil consumption calculated corresponding to the common-rail-pressure force Pr which the pressure sensor detected just before initiation of subinjection is compared. The amount of descent of the common-rail-pressure force Pr becomes that the target secondary injection

quantity Qt is beyond the set point of fuel oil consumption with sufficient value. The **** injection quantity Qa more than the minimum fuel oil consumption Ql is detectable from the amount of descent of the common-rail-pressure force Pr, it is stabilized and feedback control of the fuel oil consumption in the subinjection which makes the **** injection quantity Qa in agreement with the target secondary injection quantity Qt can be performed. When the target secondary injection quantity Qt is smaller than the set point of fuel oil consumption, the feedback control of subinjection can be suspended, for example, open loop control can be performed. Although minimum fuel-oil-consumption Ql itself is sufficient as the set point of fuel oil consumption, it is desirable to consider as the value which added the proper aggregate value to the minimum fuel oil consumption Ql.

[0027] Since the graph shown in drawing 1 is the data **** thing of the point of a finite individual, the minimum fuel oil consumption Ql is usually calculated with the approximation curve which connects the point of the interpolation based on the polygonal line which connects the point of the finite individual given as data, or a finite individual.

[0028] A controller 12 outputs the command pulse which controls the driving signal to an actuator 26 in order to make the closing motion valve 32 open. The controller 12 has memorized the common-rail-pressure force Pr in front of fuel injection, the pulse width of a command pulse, and the relation between fuel oil consumption decided beforehand as map data, and asks for the pulse width of the command pulse called for according to the common-rail-pressure force Pr in front of the fuel injection which the target secondary injection quantity Qt and pressure sensor 13 in the subinjection called for according to engine operational status detected from map data.

[0029] The fuel-injection control in the common rail type fuel injection equipment by this invention is explained below based on the flow chart shown in drawing 3 - drawing 4 . Drawing 3 is a flow chart which shows the main routine of the fuel-injection control in the common rail type fuel injection equipment by this invention. Here, there are an engine speed sensor which detects an engine speed Ne, and an accelerator control input sensor which detects an accelerator control input Ac like the amount of accelerator pedal treading in as a thing showing the load to an engine as a detection means to detect engine operational status. As shown in drawing 3 , as engine operational status, an engine speed Ne is detected by the engine speed sensor (step 1), and the accelerator control input Ac is detected by the accelerator control input sensor (step 2). The target secondary injection quantity Qt and the target secondary fuel injection timing T are called for by referring to the map data (not shown) decided beforehand based on the engine speed Ne and the accelerator control input Ac which were detected at step 1 and step 2 (step 3, step 4). The common-rail-pressure force Pr is computed from the sampling detecting signal of a pressure sensor 13 (step 5). Target common-rail-pressure force Pr 0 required in order to obtain the target secondary injection quantity Qt calculated at step 3 It is determined (step 6). By controlling the rate (for example, duty ratio of a solenoid valve) of defining closing motion of the flow control valve 14 of the high-pressure fuel pump 8, the common-rail-pressure force Pr is the target common-rail-pressure force Pr 0. It is controlled to become (step 7).

[0030] Drawing 4 is a flow chart which shows the amendment control routine in subinjection. With the pressure sensor 13, from the common-rail-pressure force Pr by which sampling detection was carried out, it passes through proper data smoothing, the common-rail-pressure force Prh in front of subinjection of each gas column and the common-rail-pressure force Prl immediately after subinjection termination are searched for, and the memory of a controller 12 memorizes. First, the common-rail-pressure force Prh and Prl of in front of subinjection and an immediately after is read from the memory of a controller 12 (step 10). Amount of descent deltaPr (= Prh-Prl) of the common-rail-pressure force Prh before subinjection and the common-rail-pressure force which descended by subinjection is calculated (step 11). The **** injection quantity Qa of the fuel injected in subinjection is computed from the map data shown in drawing 2 (step 12), and the target secondary injection quantity Qt calculated at step 3 is read from amount of descent deltaPr of the common-rail-pressure force Prh before subinjection, and the common-rail-pressure force (step 13). It is based on the graph (map data) which sets to drawing 1 and shows the relation between the common-rail-pressure force Pr and the detectable minimum fuel oil consumption Ql defined beforehand, and the minimum fuel oil consumption Ql is computed with the

fuel-oil-consumption set point Qs corresponding to the common-rail-pressure force Prh in front of subinjection, i.e., this example, (step 14). In addition, the fuel-oil-consumption set point Qs can also be made into a slightly larger value than the minimum fuel oil consumption Ql as already explained.

[0031] The target secondary injection quantity Qt read at step 13 and the minimum fuel oil consumption Ql computed at step 14 are measured (step 15). a target -- secondary -- the injection quantity -- Qt -- the minimum -- fuel oil consumption -- Ql -- the above -- it is -- a case -- **** -- last time -- fuel injection -- the time -- it can set -- a book -- a routine -- activation -- the time -- a step -- 13 -- reading -- having had -- a target -- secondary -- the injection quantity -- Qt -- ' -- a target -- secondary -- the injection quantity -- Qt -- ' -- being based -- injecting -- having had -- **** -- the injection quantity -- Qa (it computes at step 12) -- using -- a correction factor -- K (K=Qt'/Qa) -- asking -- having (step 16) . The target secondary injection quantity Qt is amended by the feedback control using a correction factor K, and the correction target secondary injection quantity Qc (Qc=KxQt) is calculated by it (step 17). The command pulse width of face corresponding to the correction target secondary injection quantity Qc is computed from map data (step 18). the driving signal according to command pulse width of face -- the electromagnetism of an injector 1 -- an actuator 26 is supplied and a fuel is injected from an injector 1 (step 19).

[0032] In the comparison of step 15, when the target secondary injection quantity Qt is under the minimum fuel oil consumption Ql, the target secondary injection quantity Qt is set to the correction target secondary injection quantity Qc, and step 19 and step 20 are hereafter performed according to the set-up correction target secondary injection quantity Qc.

[0033] this time -- fuel injection -- it can set -- secondary -- injection -- a target -- secondary -- the injection quantity -- amendment -- setting -- this time -- **** -- the injection quantity -- Qa -- receiving -- last time -- a target -- secondary -- the injection quantity -- Qt -- ' -- a ratio (Qt'/Qa) -- ****** -- having asked -- a correction factor -- having used -- an example -- having been shown -- although -- this time -- **** -- the injection quantity -- Qa -- the above -- a target -- secondary -- the injection quantity -- Qt -- ' -- deflection -- delta -- Q (Qa-Qt') -- being based -- this subinjection quantity -- you may amend . That is, it is, even if it amends the target secondary injection quantity Qt in this combustion cycle according to deflection deltaQ to the same injector 1, and it calculates the correction target secondary injection quantity Qc, and changes the pulse width of the command pulse corresponding to the correction target secondary injection quantity Qc or calculates the amount of amendments of the pulse width of a command pulse according to deflection deltaQ, and it is **.

[0034]

[Effect of the Invention] According to the common rail type fuel injection equipment by this invention, the fuel breathed out from the high-pressure fuel pump is stored in a common rail by the pressure accumulation condition. The fuel supplied from the common rail is injected by the combustion chamber from an injector. A controller The fuel injection from an injector is controlled based on the target fuel oil consumption calculated according to the detecting signal from a detection means which detects engine operational status. Since feedback control is suspended when the target secondary injection quantity in subinjection is smaller than the fuel-oil-consumption set point calculated based on the common-rail-pressure force, the feedback control of the fuel injection in subinjection does not become unstable. Therefore, even if it is the individual difference of each injector, or the same injector, it can prevent that faults which originated in change at the time of the path of the injection property, such as vibration and noise, and aggravation of an exhaust gas property, arise. In addition, fuel-injection control by this invention cannot always be performed, but it can also be used for decision of the existence of degradation with the passage of time in temporary study or each injector.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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TECHNICAL FIELD

[Field of the Invention] Especially this invention relates to the common rail type fuel injection equipment performed by the subinjection which precedes fuel injection with the main injection and this main injection, or is delayed about a common rail type fuel injection equipment, and injects a little fuel.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] Conventionally, about engine fuel injection, high-pressure-ization of an injection pressure is attained and the common rail fuel-injection system is known as a method which controls injection conditions, such as injection timing of a fuel, and injection quantity, the optimal according to engine operational status. A common rail fuel-injection system is a system injected to a combustion chamber from each injector arranged at two or more gas columns on the optimal fuel-injection conditions which the fuel pressurized by the predetermined pressure was stored in the state of pressure accumulation in the common rail, and the controller asked for the stored pressurization fuel according to the operational status of engines, such as fuel oil consumption and fuel injection timing, with the fuel pump, respectively. In the fuel passage which results in the nozzle hole formed at the tip of each injector through the fuel feeding pipe from the common rail, the fuel pressure of an injection pressure is acting, and each injector is always equipped with the solenoid valve in order to perform control which passes or intercepts the fuel supplied through a fuel feeding pipe. The controller is controlling the pressure of a common rail, and actuation of the solenoid valve of each injector so that a pressurization fuel is injected on the optimal injection conditions to engine operational status in each injector. There is a thing of a format which operates an injector as a working fluid by actuation of a solenoid valve using some high-pressure fuels in a common rail fuel-injection system.
[0003] Drawing 5 is drawing showing the outline of a common rail fuel-injection system. In a common rail fuel-injection system, after the fuel in a fuel tank 4 passes through a filter 5 and a feed pump 6, it is supplied to the fuel pump 8 which is plunger-type variable-capacity type high pressure pumping through a fuel pipe 7. A fuel pump 8 is driven by engine power, carries out a pressure up to the predetermined pressure of which a fuel is required, and is supplied to a common rail 2 through a fuel pipe 9. In order to maintain the fuel pressure in a common rail 2 to a predetermined pressure, the flow control valve 14 is arranged by the fuel pump 8. The fuel relieved from the fuel pump 8 returns to a fuel tank 4 through the return tubing 10. The fuel in a common rail 2 is supplied to two or more injectors 1 through a fuel feeding pipe 3. The fuel which was not spent on the injection to a combustion chamber among the fuels supplied to the injector 1 from the fuel feeding pipe 3 returns to a fuel tank 4 through the return tubing 11.
[0004] The signal from the various sensors for detecting engine operational status, such as a pressure sensor of inhalation of air for detecting the coolant temperature sensor for detecting the accelerator opening sensor for detecting the crank angle sensor for detecting a gas column distinction sensor, an engine engine speed Ne, and an engine top dead center (TDC) and the amount Ac of accelerator pedal treading in and a circulating water temperature and the pressure of inhalation of air, is inputted into the controller 12 which is an electronic control unit. The pressure sensor 13 is formed in the common rail 2, and the detecting signal of the fuel pressure in the common rail 2 detected by the pressure sensor 13 (henceforth the common-rail-pressure force) is also inputted into a controller 12. A controller 12 controls fuel injection timing (the injection initiation stage and period), injection quantity, etc. of the injection conditions of the fuel by the injector 1, i.e., a fuel, so that engine power turns into the optimal output adapted to operational status based on these signals. Although the fuel in a common rail 2 is

consumed because an injector 1 injects a fuel, and the fuel pressure in a common rail falls, in order that a controller 12 may obtain the fuel injection pressure needed according to engine operational status so that the fuel pressure in a common rail 2 may become fixed or, it controls the flow control valve 14 of a fuel pump 8, and controls a discharge pressure. In the example of illustration, although an engine is a six cylinder engine, they may be other numbers of gas columns, such as a 4-cylinder.

[0005] Drawing 6 is drawing of longitudinal section showing an example of the injector used for a common rail type fuel-injection system. An injector 1 is attached in the hole prepared in the bases, such as the cylinder head to which illustration was abbreviated, by the seal member at a seal condition. The fuel feeding pipe 3 is connected to the top flank of an injector 1 through the fuel inlet-port joint 20. The fuel paths 21 and 22 are formed in the interior of the body of an injector 1, and fuel passage consists of a fuel feeding pipe 3 and fuel paths 21 and 22. The fuel supplied through fuel passage is injected by the combustion chamber through the path around the reserve-well ball 23 and a needle valve 24 from the nozzle hole 25 opened at the time of the lift of a needle valve 24.

[0006] In order to control the lift of a needle valve 24, the needle-valve lift device of a balance chamber type is prepared in the injector 1. the electromagnetism which constitutes a solenoid valve in the topmost part of an injector 1 -- the control current the actuator 26 is formed and corresponding to the command pulse of a controller 12 -- a signal line 27 -- leading -- electromagnetism -- it is sent to the solenoid 28 of an actuator 26. If a solenoid 28 is excited, since the closing motion valve 32 which the armature 29 went up and was prepared in the edge of the fuel way 31 will be opened, the fuel pressure of the fuel supplied to the balance chamber 30 is released from fuel passage through the fuel way 31. In the hollow hole 33 formed in the interior of the body of an injector 1, the control piston 34 is formed possible [rise and fall]. Since the force which pushes up a control piston 34 rather than the push-down force committed to a control piston 34 based on the fuel pressure which acts on the taper side 36 which attends the reserve-well ball 23 according to the force and the spring force of a return spring 35 based on the pressure in the lowered balance chamber 30 excels, a control piston 34 goes up. Consequently, a needle valve 24 carries out a lift and a fuel is injected from a nozzle hole 25. Fuel injection timing is set by the lift stage of a needle valve 24, and fuel oil consumption is defined by the fuel pressure in fuel passage, and the lift (the amount of lifts, lift period) of a needle valve 24.

[0007] Generally, the relation between the fuel oil consumption of an injector 1 and the pulse width of the command pulse which a controller 12 outputs is defined on the map which made the parameter the common-rail-pressure force Pr (fuel pressure in a common rail 2). If the common-rail-pressure force Pr is set constant, even if fuel oil consumption increases and it is the same pulse width so that pulse width is large, fuel oil consumption will become large, so that the common-rail-pressure force Pr is size. On the other hand, since it starts with the falling time of day of a command pulse, and it is fixed-time-behind to time of day and is started or stopped, fuel injection can control injection timing, when a command pulse controls ON or the stage to become off. Between the basic injection quantity and an engine speed, the amount of accelerator pedal treading in is beforehand given to relation fixed as a parameter as a basic characteristics-of-spray-amount map, and the fuel oil consumption for every combustion cycle is calculated by count from a basic characteristics-of-spray-amount map according to engine operational status.

[0008] Conventionally, in the diesel power plant, the so-called pilot injection control which injects a little fuel in advance of the main injection is performed. While preventing that prevent that the fuel which the temperature of a combustion chamber was raised beforehand and injected by performing pilot injection burns rapidly, consequently the so-called diesel knock arises, reducing the rate of the nitrogen oxides contained in exhaust gas is performed. Moreover, the pilot injection quantity is determined in consideration of the yield of the nitrogen oxides for which it asked experimentally, considering the purpose of pilot injection. In the pilot injection quantity decided by such decision approach, combustion becomes slow and bad influences, such as a surging, may arise. Since that pilot injection is needed has the common case where an engine operating range is a low loading idle operating range, the pilot injection quantity is calculated as the ratio to the total fuel oil consumption, or uniform absolute magnitude, and, generally its rate to the total injection quantity is also small little also as absolute

magnitude.
[0009] By the way, in order for there to be path yearly change from which a property changes with the passage of time in the injection property (especially fuel injection timing, injection quantity) of an injector even if it is the individual variation from which a property differs for every injector, and the same injector, and to make the common-rail-pressure force and an injector drive, even if the command pulse period used as ON is the same, usually the fuel oil consumption injected from an injector also differs. Although it does not become a big problem even if some differences are in the injection quantity of each injector, when fuel-oil-consumption itself is a big value, when performing fuel injection with minute fuel oil consumption like [in pilot injection], the effect of individual variation and path yearly change becomes remarkable, and it may result in the situation where a lot of fuels as pilot injection are not injected, or fuel injection is not performed at all. When the gas column in which pilot injection is performed at the time of the low loading which needs pilot injection, or idle operation, and the gas column which is not performed exist, combustion will not be stabilized but displeasure will be given to the operator of a car on the contrary.
[0010] In order to reduce the variation in fuel oil consumption, these people computed actual fuel oil consumption based on the amount of descent of the common-rail-pressure force at the time of fuel injection, and they have proposed the control approach which amends a controlled variable so that it may be in agreement with the target fuel oil consumption calculated based on engine operational status (Japanese Patent Application No. No. 186639 [ten to]). According to this control approach, corresponding to the amount of descent of the common-rail-pressure force in front of fuel injection, and the common-rail-pressure force before and behind fuel injection, actual fuel oil consumption can be calculated from map data. That is, calculating actual fuel oil consumption is proposed by using the data of the detecting signal from the pressure sensor formed in order to detect the common-rail-pressure force in a common rail fuel-injection system. In this control approach, it faces in quest of actual fuel oil consumption, and in order to perform fuel injection, the dynamic amount of fuel leaks which a fuel leaks from the pressure control room of an injector is taken into consideration.
[0011] By the way, there is a field which cannot calculate actual fuel oil consumption correctly in the map in which the relation between the amount of descent of the common-rail-pressure force and fuel oil consumption was shown from the amount of descent of the common-rail-pressure force. Drawing 2 is the graph which showed the relation between fuel oil consumption and the amount of common-rail-pressure force descent by making the common-rail-pressure force into a parameter. In the amount of descent of the common-rail-pressure force below threshold deltaPs (for example, 1Mpa), the relation between the common-rail-pressure force Pr and fuel oil consumption Q becomes less clear on a graph, and actual fuel oil consumption cannot be correctly calculated according to the common-rail-pressure force Pr so that drawing 2 may show. That is, in the amount of descent of the common-rail-pressure force below threshold deltaPs shown in drawing 2 , since actual fuel oil consumption cannot be calculated correctly, feedback control with the exact fuel oil consumption which makes actual fuel oil consumption in agreement with target fuel oil consumption cannot be performed, either.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] According to the common rail type fuel injection equipment by this invention, the fuel breathed out from the high-pressure fuel pump is stored in a common rail by the pressure accumulation condition. The fuel supplied from the common rail is injected by the combustion chamber from an injector. A controller The fuel injection from an injector is controlled based on the target fuel oil consumption calculated according to the detecting signal from a detection means which detects engine operational status. Since feedback control is suspended when the target secondary injection quantity in subinjection is smaller than the fuel-oil-consumption set point calculated based on the common-rail-pressure force, the feedback control of the fuel injection in subinjection does not become unstable. Therefore, even if it is the individual difference of each injector, or the same injector, it can prevent that faults which originated in change at the time of the path of the injection property, such as vibration and noise, and aggravation of an exhaust gas property, arise. In addition, fuel-injection control by this invention cannot always be performed, but it can also be used for decision of the existence of degradation with the passage of time in temporary study or each injector.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Therefore, fuel injection is performed by the subinjection carried out to the main injection and the main injection by being preceded or delayed. The target secondary injection quantity of the fuel with which a controller should be injected by the combustion chamber from an injector in subinjection is calculated. In the common rail type fuel injection equipment which performs feedback control of subinjection so that the **** injection quantity actually injected in subinjection may turn into target secondary injection quantity When the target injection quantity in subinjection turns into under the injection quantity computable from the amount of descent of the common-rail-pressure force, it is necessary to avoid that the controlled variable of the fuel oil consumption in the feedback control of subinjection becomes unstable.

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] The purpose of this invention stores in a pressure accumulation condition the fuel breathed out from the high-pressure fuel pump at a common rail. An injector injects the fuel supplied from the common rail to a combustion chamber. In the common rail type fuel injection equipment which is controlling the fuel injection from an injector based on the target fuel oil consumption asked for a controller according to the detecting signal from a detection means which detects engine operational status When the target secondary injection quantity in subinjection is injection quantity smaller than the minimum detectable fuel oil consumption based on the common-rail-pressure force It is offering the common rail type fuel injection equipment which can prevent the noise resulting from avoiding the feedback control of the fuel injection in subinjection becoming unstable, and becoming impossible as for the feedback control of normal subinjection, aggravation of an exhaust gas property, etc.
[0014] The common rail which stores in a pressure accumulation condition the fuel with which this invention was breathed out from the high-pressure fuel pump, The injector which injects the fuel supplied from said common rail to a combustion chamber, A detection means to detect engine operational status, the pressure sensor which detects the fuel pressure of said common rail, And the target injection quantity of the fuel which should be injected from said injector according to the detecting signal from said detection means is calculated. The controller which controls the fuel injection from said injector based on said target injection quantity is provided. Said controller Said fuel injection from said injector is divided into the subinjection which responds to a detecting signal from said detection means, and is preceded or delayed to the main injection and this main injection. According to the detecting signal from said detection means, compute the target secondary injection quantity, and the **** injection quantity of the fuel actually injected in said subinjection based on the amount of descent of said fuel pressure of said common rail is computed. In the common rail type fuel injection equipment which consists of performing feedback control of said subinjection so that said **** injection quantity may be in agreement with said target secondary injection quantity said controller The fuel-oil-consumption set point calculated corresponding to the fuel pressure of said common rail which said target secondary injection quantity and said pressure sensor detected is compared. When said target secondary injection quantity is smaller than said fuel-oil-consumption set point, it is related with the common rail type fuel injection equipment characterized by suspending said feedback control.
[0015] According to the common rail type fuel injection equipment by this invention, a controller divides the fuel injection from an injector into the subinjection which responds to the detecting signal which detects engine operational status from a detection means, and is preceded or delayed to the main injection and this main injection, and computes the target secondary injection quantity as a part of target total injection quantity of the fuel which should be injected in subinjection according to the detecting signal from a pressure sensor which detects the fuel pressure of a common rail. Although the fuel pressure of a common rail will descend if fuel injection is performed from an injector Although a controller will perform feedback control of subinjection so that the **** injection quantity may be in agreement with the target secondary injection quantity if the **** injection quantity which the target

secondary injection quantity is a sufficiently big value, and is the fuel quantity actually injected in subinjection is computable based on the amount of descent of the fuel pressure of a common rail When it is not sufficient big value whose calculation of the **** injection quantity the target secondary injection quantity enables, the feedback control of the subinjection which is easy to fall unstably is suspended, and faults resulting from the feedback control of normal subinjection becoming impossible, such as noise and aggravation of an exhaust gas property, are prevented.
[0016] Said fuel-oil-consumption set point is computed based on the relation beforehand defined between the minimum fuel oil consumption detectable [with the pressure variation produced in the fuel pressure of said common rail, and the fuel pressure of said common rail] as injection quantity more than said minimum fuel oil consumption calculated according to the detecting signal from said pressure sensor. Therefore, the **** injection quantity injected for the purpose of the target secondary injection quantity which the target secondary injection quantity is not set under to the detectable minimum fuel oil consumption, and was set up such becomes computable from the fuel pressure data of the common rail which the pressure sensor detected, and the feedback control of subinjection does not become unstable. Said relation between said fuel pressure of said common rail and said minimum fuel oil consumption is defined corresponding to the amount of the minimum descent which can detect said fuel pressure of said common rail from the relation of the amount of descent of said fuel pressure of said common rail in front of said fuel injection, and said fuel pressure of said common rail which descended by said fuel injection, and the fuel oil consumption injected in said fuel injection. The relation between the amount of descent of the fuel pressure of the common rail which descended by fuel injection, and the fuel oil consumption injected by the fuel injection is specifically beforehand called for in the form of map data by making fuel pressure of the common rail in front of the fuel injection into a parameter, and the relation between the minimum fuel oil consumption and the fuel pressure of a common rail is called for corresponding to the amount of the minimum descent of fuel pressure detectable [with a pressure sensor].
[0017] When said target secondary injection quantity is smaller than said fuel-oil-consumption set point, open loop control which made said target secondary injection quantity desired value is performed. That is, when the target secondary injection quantity is smaller than the fuel-oil-consumption set point, it replaces with the feedback control which was being performed based on the deflection of the target secondary injection quantity and the **** injection quantity etc., and open loop control without feedback of the **** injection quantity is performed.
[0018] Said injector possesses the actuator which operates the needle valve which opens and closes the nozzle hole which injects the fuel which went up and down based on the pressure operation of the fuel in the pressure control room where some fuels supplied from said common rail are introduced, and said pressure control room, and was formed in the point of said injector, the closing-motion valve which releases the fuel pressure in said pressure control room by discharging the fuel in said pressure control room, and said closing-motion valve. If a controller operates an actuator, a closing motion valve will open, the fuel in the pressure control room supplied from the common rail will be discharged, and the fuel pressure in pressure control room will be released. When the pressure of the fuel in pressure control room declines, a needle valve goes up based on fuel pressure, the nozzle hole formed in the point of an injector opens, and a fuel is injected to a combustion chamber.
[0019] Said controller outputs the command pulse which controls the driving signal to said actuator in order to make said closing motion valve open, and it performs said feedback control of said subinjection by amending the pulse width of said command pulse based on the deflection of said **** injection quantity and said target secondary injection quantity. By amending the target secondary injection quantity in next fuel injection to the same injector as a concrete example of 1 control, calculating the correction target secondary injection quantity, and changing the pulse width of the command pulse corresponding to the correction target secondary injection quantity, it is controlled so that the **** injection quantity is in agreement with the target secondary injection quantity in subinjection of the next time from an injector.
[0020]

[Embodiment of the Invention] Hereafter, with reference to a drawing, the example of the common rail type fuel injection equipment by this invention is explained. Drawing 1 is a graph which shows the relation of the common-rail-pressure force and fuel oil consumption corresponding to the threshold of common-rail-pressure force descent of the amount of common-rail-pressure force descent, i.e., the minimum detectable amount, from the graph shown in drawing 2 .
[0021] The injector used for a common rail type fuel-injection system and this system can apply the system and injector which were shown in drawing 5 and drawing 6 , respectively as it is. namely, speaking of an injector 1 As pressure control room where some fuels supplied from a common rail 2 are introduced It goes up and down based on a pressure operation of the fuel in the ** balance chamber 30 and a balance chamber 30. By discharging the fuel in the needle valve 24 which opens and closes the nozzle hole 25 which injects the fuel formed in the point of an injector 1, and a balance chamber 30 the electromagnetism which operates the closing motion valve 32 which releases the fuel pressure in a balance chamber 30, and the closing motion valve 32 -- about the point of having the actuator 26, you may be the same as that of the injector 1 shown in drawing 6 , and the detailed explanation for the second time about other details is omitted.
[0022] Corresponding to the fuel injection of every [in an engine cycle] gas column, the common-rail-pressure force Pr started descent with the time lag from injection initiation, and has repeated the cycle of recovering according to the regurgitation of the fuel from the high-pressure fuel pump 8 for the fuel injection in the gas column in which combustion is performed next according to combustion sequence, after injection termination. Since an engine is a multiple cylinder engine as shown in drawing 5 , the controller 12 is controlling fuel injection from an injector 1 according to each gas column.
[0023] In the graph of drawing 1 , an axis of abscissa is the fuel pressure Pr of a common rail, i.e., the common-rail-pressure force, and the axis of ordinate shows the minimum fuel oil consumption Ql detectable from the amount of descent of the common-rail-pressure force. The curve f shown in the graph of drawing 1 shows that the minimum fuel oil consumption Ql detectable from the amount of descent of the common-rail-pressure force Pr changes with the magnitude of the common-rail-pressure force Pr. That is, although it is detectable to the minimum fuel oil consumption Ql of such a small value that the common-rail-pressure force Pr is high, the minimum fuel oil consumption detectable, so that the common-rail-pressure force Pr is low serves as a big value. From the graph of drawing 1 , the detectable minimum fuel oil consumption according to the common-rail-pressure force Pr is defined.
[0024] The graph shown in drawing 1 is called for from the graph shown in drawing 2 . Drawing 2 is the graph which drew as a parameter the common-rail-pressure force Pr (value in front of injection) detected by the pressure sensor 13 currently arranged by the common rail 2 in the relation between fuel oil consumption Q and amount of descent deltaPr of the common-rail-pressure force in the common rail type fuel injection equipment by this invention. Although many [so / that the common-rail-pressure force Pr is high if fuel oil consumption Q has the the same fuel fuel injection period of an injector 1], if the common-rail-pressure force Pr in front of fuel injection is the same, amount of pressure drawdowns deltaPr of a common rail will increase, so that there is much fuel oil consumption Q from an injector 1. Moreover, amount of descent deltaPr of the common-rail-pressure force becomes large, so that the common-rail-pressure force Pr is high, when the same fuel oil consumption Q is injected. Since there is threshold deltaPs as limit of detection of amount of descent deltaPr of the common-rail-pressure force, the minimum fuel oil consumption Ql calculated according to threshold deltaPs will change according to the common-rail-pressure force Pr, and this relation is expressed with the graph of drawing 1 .
[0025] When fuel injection is divided into the main injection and the subinjection preceded or delayed to this main injection and is performed, If it seems that it may be computed according to the common-rail-pressure force Pr in front of initiation of subinjection as under the minimum fuel oil consumption Ql as which the target secondary injection quantity Qt is determined with the curve f of drawing 1 The **** injection quantity Qa of the fuel actually injected in subinjection serves as a value of the field below the curve f of drawing 1 , and it becomes impossible to compute the **** injection quantity Qa correctly in this case by the common-rail-pressure force Pr and its amount of descent deltaPr. Consequently, in the feedback control of subinjection, the controlled variable of fuel oil consumption may become unstable,

and combustion may become unstable. That is, originally, when it is the pilot injection to which subinjection precedes with the main injection and is performed, since there is little injection quantity, control of the pilot injection which it becomes impossible to have detected actual fuel oil consumption correctly, and was stabilized becomes impossible from amount of descent deltaPr of the common-rail-pressure force Pr.

[0026] Therefore, the target secondary injection quantity Qt calculated according to engine operational status The set point of the fuel oil consumption calculated corresponding to the common-rail-pressure force Pr which the pressure sensor detected just before initiation of subinjection is compared. The amount of descent of the common-rail-pressure force Pr becomes that the target secondary injection quantity Qt is beyond the set point of fuel oil consumption with sufficient value. The **** injection quantity Qa more than the minimum fuel oil consumption Ql is detectable from the amount of descent of the common-rail-pressure force Pr, it is stabilized and feedback control of the fuel oil consumption in the subinjection which makes the **** injection quantity Qa in agreement with the target secondary injection quantity Qt can be performed. When the target secondary injection quantity Qt is smaller than the set point of fuel oil consumption, the feedback control of subinjection can be suspended, for example, open loop control can be performed. Although minimum fuel-oil-consumption Ql itself is sufficient as the set point of fuel oil consumption, it is desirable to consider as the value which added the proper aggregate value to the minimum fuel oil consumption Ql.

[0027] Since the graph shown in drawing 1 is the data **** thing of the point of a finite individual, the minimum fuel oil consumption Ql is usually calculated with the approximation curve which connects the point of the interpolation based on the polygonal line which connects the point of the finite individual given as data, or a finite individual.

[0028] A controller 12 outputs the command pulse which controls the driving signal to an actuator 26 in order to make the closing motion valve 32 open. The controller 12 has memorized the common-rail-pressure force Pr in front of fuel injection, the pulse width of a command pulse, and the relation between fuel oil consumption decided beforehand as map data, and asks for the pulse width of the command pulse called for according to the common-rail-pressure force Pr in front of the fuel injection which the target secondary injection quantity Qt and pressure sensor 13 in the subinjection called for according to engine operational status detected from map data.

[0029] The fuel-injection control in the common rail type fuel injection equipment by this invention is explained below based on the flow chart shown in drawing 3 - drawing 4 . Drawing 3 is a flow chart which shows the main routine of the fuel-injection control in the common rail type fuel injection equipment by this invention. Here, there are an engine speed sensor which detects an engine speed Ne, and an accelerator control input sensor which detects an accelerator control input Ac like the amount of accelerator pedal treading in as a thing showing the load to an engine as a detection means to detect engine operational status. As shown in drawing 3 , as engine operational status, an engine speed Ne is detected by the engine speed sensor (step 1), and the accelerator control input Ac is detected by the accelerator control input sensor (step 2). The target secondary injection quantity Qt and the target secondary fuel injection timing T are called for by referring to the map data (not shown) decided beforehand based on the engine speed Ne and the accelerator control input Ac which were detected at step 1 and step 2 (step 3, step 4). The common-rail-pressure force Pr is computed from the sampling detecting signal of a pressure sensor 13 (step 5). Target common-rail-pressure force Pr 0 required in order to obtain the target secondary injection quantity Qt calculated at step 3 It is determined (step 6). By controlling the rate (for example, duty ratio of a solenoid valve) of defining closing motion of the flow control valve 14 of the high-pressure fuel pump 8, the common-rail-pressure force Pr is the target common-rail-pressure force Pr 0. It is controlled to become (step 7).

[0030] Drawing 4 is a flow chart which shows the amendment control routine in subinjection. With the pressure sensor 13, from the common-rail-pressure force Pr by which sampling detection was carried out, it passes through proper data smoothing, the common-rail-pressure force Prh in front of subinjection of each gas column and the common-rail-pressure force Prl immediately after subinjection termination are searched for, and the memory of a controller 12 memorizes. First, the common-rail-pressure force

Prh and Prl of in front of subinjection and an immediately after is read from the memory of a controller 12 (step 10). Amount of descent deltaPr (= Prh-Prl) of the common-rail-pressure force Prh before subinjection and the common-rail-pressure force which descended by subinjection is calculated (step 11). The **** injection quantity Qa of the fuel injected in subinjection is computed from the map data shown in drawing 2 (step 12), and the target secondary injection quantity Qt calculated at step 3 is read from amount of descent deltaPr of the common-rail-pressure force Prh before subinjection, and the common-rail-pressure force (step 13). It is based on the graph (map data) which sets to drawing 1 and shows the relation between the common-rail-pressure force Pr and the detectable minimum fuel oil consumption Ql defined beforehand, and the minimum fuel oil consumption Ql is computed with the fuel-oil-consumption set point Qs corresponding to the common-rail-pressure force Prh in front of subinjection, i.e., this example, (step 14). In addition, the fuel-oil-consumption set point Qs can also be made into a slightly larger value than the minimum fuel oil consumption Ql as already explained.

[0031] The target secondary injection quantity Qt read at step 13 and the minimum fuel oil consumption Ql computed at step 14 are measured (step 15). a target -- secondary -- the injection quantity -- Qt -- the minimum -- fuel oil consumption -- Ql -- the above -- it is -- a case -- **** -- last time -- fuel injection -- the time -- it can set -- a book -- a routine -- activation -- the time -- a step -- 13 -- reading -- having had -- a target -- secondary -- the injection quantity -- Qt -- ' -- a target -- secondary -- the injection quantity -- Qt -- ' -- being based -- injecting -- having had -- **** -- the injection quantity -- Qa (it computes at step 12) -- using -- a correction factor -- K (K=Qt'/Qa) -- asking -- having (step 16) . The target secondary injection quantity Qt is amended by the feedback control using a correction factor K, and the correction target secondary injection quantity Qc (Qc=KxQt) is calculated by it (step 17). The command pulse width of face corresponding to the correction target secondary injection quantity Qc is computed from map data (step 18). the driving signal according to command pulse width of face -- the electromagnetism of an injector 1 -- an actuator 26 is supplied and a fuel is injected from an injector 1 (step 19).

[0032] In the comparison of step 15, when the target secondary injection quantity Qt is under the minimum fuel oil consumption Ql, the target secondary injection quantity Qt is set to the correction target secondary injection quantity Qc, and step 19 and step 20 are hereafter performed according to the set-up correction target secondary injection quantity Qc.

[0033] this time -- fuel injection -- it can set -- secondary -- injection -- a target -- secondary -- the injection quantity -- amendment -- setting -- this time -- **** -- the injection quantity -- Qa -- receiving -- last time -- a target -- secondary -- the injection quantity -- Qt -- ' -- a ratio (Qt'/Qa) -- ****** -- having asked -- a correction factor -- having used -- an example -- having been shown -- although -- this time -- **** -- the injection quantity -- Qa -- the above -- a target -- secondary -- the injection quantity -- Qt -- ' -- deflection -- delta -- Q (Qa-Qt') -- being based -- this subinjection quantity -- you may amend . That is, it is, even if it amends the target secondary injection quantity Qt in this combustion cycle according to deflection deltaQ to the same injector 1, and it calculates the correction target secondary injection quantity Qc, and changes the pulse width of the command pulse corresponding to the correction target secondary injection quantity Qc or calculates the amount of amendments of the pulse width of a command pulse according to deflection deltaQ, and it is **.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] In the common rail type fuel injection equipment by this invention, it is the graph which shows the relation between the common-rail-pressure force and the minimum fuel oil consumption calculated from that limit of detection.
[Drawing 2] In the common rail type fuel injection equipment by this invention, it is the graph which shows the relation of the fuel oil consumption and the amount of descent of the common-rail-pressure force which made the common-rail-pressure force the parameter.
[Drawing 3] It is the flow chart in the common rail type fuel injection equipment by this invention which shows the main routine of subinjection control.
[Drawing 4] It is the flow chart in the common rail type fuel injection equipment by this invention which shows the amendment control routine of subinjection control.
[Drawing 5] It is the schematic diagram showing the conventional common rail type fuel-injection system.
[Drawing 6] It is the sectional view showing an example of the injector used for the common rail type fuel-injection system shown in drawing 5 .
[Description of Notations]
1 Injector
2 Common Rail
3 Fuel Feeding Pipe
8 Fuel Feed Pump
12 Controller
13 Pressure Sensor
24 Needle Valve
25 Nozzle Hole
26 Electromagnetism -- Actuator
30 Balance Chamber
32 Closing Motion Valve
Pr Common-rail-pressure force
deltaPr The amount of descent of the common-rail-pressure force
deltaPs Threshold of the amount of descent of the common-rail-pressure force
Qt Target secondary injection quantity
Qt' The last target secondary injection quantity
Qa **** injection quantity
Qs Fuel-oil-consumption set point
Ql The minimum fuel oil consumption
Qc Correction target secondary injection quantity
K Correction factor

[Translation done.]